Applying the pyeloplasty predictive score in patients with ureteropelvic junction obstruction

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Summary

Background
Ureteropelvic junction obstruction (UPJO) is an anatomical lesion in the renal collecting system and is one of the most common congenital causes of hydronephrosis, occurring in 1—5 % of pregnancies. Surgical predictive scores have been extensively studied as a promising way to assist and optimize management in cases of UPJO.

Objective
Apply the pyeloplasty predictive score and evaluate its effectiveness in patients with UPJO treated at a tertiary care hospital.

Study design
The Pyeloplasty Prediction Score (PPS) was retrospectively applied to patients diagnosed with UPJO and treated at a tertiary care hospital. The PPS is based on the Society for Fetal Urology grading system, the anteroposterior diameter of the pelvis, and the absolute percentage of the difference in renal length. The PPS ranges from 0 to 12 and is calculated by adding each of the scored variables, classifying surgical risk as low, intermediate, and high.

Results
Out of the 48 kidney units studied, 18 did not undergo surgical treatment, and 30 underwent pyeloplasty. The number of units with low, intermediate, and high non-surgical PPS was 8, 8, and 2, respectively, and surgical PPS was 1, 8, and 21. The sensitivity of the PPS was 96.67 %, and the specificity was 44.44 %. The positive predictive value was 74.36 %, and the negative predictive value was 88.89 %.

Discussion
The majority of surgical kidney units had a high score. The only patient operated on with low risk had associated vesicoureteral reflux in the same unit. Half of the non-surgical patients had a low score. The two high-risk non-surgical cases had megacalicosis as the final diagnosis.

Conclusion
PPS may aid the clinical practice of UPJO due to its high sensitivity in high and low scores, necessitating an individualized clinical and radiological assessment in intermediate-risk cases.

Introduction

Ureteropelvic obstruction (UPJO) is one of the most common congenital causes of hydronephrosis, occurring in 1—5 % of pregnancies [1,2]. The diagnosis can be made during intra-uterine life through ultrasound and is commonly detected in the third trimester [3]. The indication for surgery in UPJO is based on clinical and radiological criteria. The deterioration of differential renal function (DRF) on renal scintigraphy (DMSA) and worsening hydronephrosis are the most used parameters. Some scoring systems have been proposed to assist and optimize management, identifying cases that require pyeloplasty and those that benefit from expectant clinical follow-up. The Pyeloplasty Prediction Score (PPS) [4] is calculated from the Society for Fetal Urology grading system, the measurement of the anteroposterior diameter of the pelvis (DAP), and the absolute percentage of the difference in renal length. The objective of this study was to evaluate the effectiveness of the PPS in UPJO patients treated in a tertiary care hospital.

Material and methods

Data from patients with UPJO followed at the outpatient clinic of the Pediatric Urology Sector of the Pediatric Surgery Discipline of the Escola Paulista de Medicina/UNIFESP between January 2018 and December 2022 were retrospectively evaluated. The PPS was based on the Society for Fetal Urology grading system, the transverse measurement of the anteroposterior diameter of the renal pelvis (DAP), and the absolute percentage of the difference in renal length as described by Bruce et al. The data necessary to calculate the PPS were collected from the ultrasound recorded at the first outpatient consultation. To calculate the absolute percentage of the length difference, it is necessary to calculate the difference between the ipsilateral and contralateral renal length, then calculate the ratio of the value obtained to the ipsilateral length, and finally, multiply by 100. The variables have values from zero to four, which are proportional to the severity of the case. The PPS ranges from 0 to 12 and is calculated by the addition of each of the scored variables (A + B + C). Thus, PPS from 0 to 4 have a low attributed risk, from 5 to 7 have an intermediate risk, and from 8 to 12 have a high risk (Appendix).

All patients underwent radiological evaluations, including ultrasound, dynamic renal scintigraphy (DTPA), static renal scintigraphy (DMSA), and blood tests. They were monitored with serial radiological examinations, especially in those managed conservatively. Patients were excluded if they had a solitary kidney, lacked adequate radiological investigation to confirm the diagnosis, or did not have sufficient data to calculate the score.

Data related to age at diagnosis and surgery, bilaterality, etiology, and initial DMSA scan were also collected. Fischer's exact test was used to compare proportions between independent samples. A p value of less than 0.05 was considered statistically significant.

Results

Out of the 59 patients with UPJO, 17 cases were excluded (10 due to lack of data, 4 due to a solitary kidney, 2 due to other associated congenital conditions, and 1 due to an incomplete diagnosis). Of the 42 patients included in the study, 33 (78.6 %) were male, and 9 (21.4 %) were female. Six patients had bilateral UPJO. Of the 48 kidney units, there was a left-sided prevalence (56.35 %). 18 (37.5 %) kidney units did not undergo surgical treatment, and 30 (62.5 %) underwent pyeloplasty. The presence of crossing renal vessels was identified in two patients. The average age at the patients' first consultation was 22.14 months, and the average age at surgery was 40.36 months (Table 1).

Among the non-surgical units, 8 were classified as low risk, 8 as medium risk, and 2 as high risk according to the PPS (Table 3). 13 renal units presented with SFU grade 2 ,2 renal units with SFU grade 3 and 3 renal units with SFU grade 4. All non-surgical patients demonstrated normal findings on the DMSA scan, with the exception of one renal unit in the intermediate-risk group, which showed decreased ipsilateral renal function and mild pelvic dilation with moderate calyceal dilation on ultrasound—later confirmed to be megacalicosis. Among the surgical cases, 21 were classified as high risk, 8 as medium risk, and 1 as low risk (Table 2). 20 renal units presented with SFU grade 4 , 5 renal units with SFU grade 3 and 5 renal units with SFU grade 2. Only one case of low risk had an abnormal DMSA scan. This patient also had vesicoureteral reflux with volumetric reduction of the affected kidney. Among high-risk patients, supranormal differential renal function (DRF above 55 %) was found in 9 cases, decreased differential renal function in 8 cases, and 2 cases presented a normal DMSA scan (both with parenchymal thinning on ultrasound). No data were available for one patient, while another high-risk case with contralateral renal functional exclusion showed straightening of the renal papillae and cortical cysts on ultrasound of the affected side. Among the intermediate-risk patients, 3 showed decreased DRF, 3 had supranormal differential renal function (SNDRF), and 2 had a normal DMSA scan—one of these demonstrated parenchymal thinning, while the other exhibited worsening pelvic dilation on ultrasound follow-up (Table 3).

In the 6 cases of bilateral UPJO, only two cases (one low risk and one intermediate risk) had a normal DMSA scan and did not undergo surgery. Of the 4 surgical cases, 2 were classified as intermediate risk, and 2 as high risk. All high-risk cases showed supranormal differential renal function, while the intermediate-risk cases had supranormal differential renal function on one side and decreased differential renal function on the contralateral side. A statistically significant difference was observed between the scores of

Table 1	Profile of cases of UPJO.	
Age at first consultation	22.1 months	
Age at surgery	40.4 months	
Sex	Male 33 (78.6 %)	Female 9 (21.4 %)
Unit	Unilateral 36 (85.7 %)	Bilateral 6 (14.3 %)
Laterality	Left 27 (56.2 %)	Right 21 (43.7 %)
Treatment	Surgical 30 (62.5 %)	Non-surgical 18 (37.5 %)
Etiology	Intrisic 28 (93.3 %)	Extrisic 2 (6.7 %)

Table 2 Distribution of the Pyeloplasty Prediction Score (PPS) between surgical and non-surgical renal units. (Fisher's exact test,: low vs. intermediate; p = 0.088, high vs. intermediate; p = 0.007, high vs. low; p < 0.001).

	PPS N (%)			Total
	High	Intermediate	Low	
Surgery				
No	2 (11.12)	8 (44.44)	8 (44.44)	18 (100)
Yes	21 (70)	8 (26.67)	1 (3.33)	30 (100)
Total	23 (48)	16 (33.3)	9 (18.7)	48 (100)

surgical and non-surgical patients (low vs. intermediate; p = 0.088, high vs. intermediate; p = 0.007, high vs. low; p < 0.001). Surgical patients tended to have higher scores, while non-surgical patients had predominantly low and intermediate scores (Table 3).

The sensitivity of PPS was 96.67 %, and the specificity was 44.44 %. The positive predictive value was 74.36 %, and the negative predictive value was 88.89 %.

Discussion

The PPS is a score based on exclusively ultrasound parameters that facilitate its replicability. The use of the SFU grading system is justified because there is an increased risk of pyeloplasty in SFU 3 and 4 [5]. The increase in the anteroposterior diameter of the pelvis both in the third trimester and on postnatal ultrasound is also associated with a greater indication for pyeloplasty [6]. Finally, renal length discrepancy was evident in kidney units with worsening in DMSA scan and with a high SFU grade [6,7]. In this study, an older age at the first consultation was observed, which may be explained by delayed referral, potentially exacerbated by the COVID-19 pandemic.10 patients were also excluded due to a lack of data, demonstrating that the standardization of the ultrasound reports is extremely important for studies related to hydronephrosis.

Out of the 48 kidney units, 32 underwent surgical treatment, corresponding to 64.3 % of the patients included in the study. In the literature, the indication for pyeloplasty occurs in approximately one-third of children with hydronephrosis in most series [8,9]. The higher incidence of surgical cases in this study can be explained by the fact that data collection was carried out in a tertiary hospital

outpatient clinic that attends patients referred from pediatric specialties.

The sensitivity of PPS in the studied sample was high (96.67 %). Most surgical kidney units had a high score (70 %). The only patient operated on with low risk had associated vesicoureteral reflux in the same unit. Atrophy of the renal parenchyma interfered with the calculation of its predictive factor by altering its length. In the original study, the pyeloplasty predictive score cutoffs were established excluding hydronephrosis with associated vesicoureteral reflux. Considering that the association of UJPO and vesicoureteral reflux occurs in approximately 10 % of patients, the predictive score must be used with the consideration that kidney scars due to recurrent urinary infections can change its values.

44.5 % of the non-surgical units had a low score. The two high-risk non-surgical cases had megacalicosis as the final diagnosis. DMSA scans were normal in both cases, helping in the decision for clinical follow-up.

42.1 % of cases were classified as intermediate scores. In non-surgical patients, DMSA scans were normal in all cases. In surgical patients, it was identified decreased differential renal function or supranormal differential renal function. Those with a normal DMSA scan also presented ultrasound findings that helped with the surgical decision. These findings support other studies that highlight the challenges of using deterioration in DRF as the sole objective criterion for surgery. They emphasize that the decision should involve a comprehensive evaluation of radiological examinations in conjunction with other clinical factors.

In bilateral UPJO, when the ipsilateral length is smaller than the contralateral, the calculation of the variable of the percentage of the difference between renal lengths results in a negative number, attributing a zero value that can compromise the PPS analysis. PPS was originally used only in unilateral hydronephrosis. However, applying the score in bilateral cases, it was observed that all surgical cases presented high or intermediate scores with supranormal differential renal function and decreased cortical thickness on ultrasound. In non-surgical cases, scores were low or intermediate with a normal DMSA scan. Therefore, the PPS can be applied in bilateral cases, provided it is interpreted with caution.

A limitation of this study is the small sample size. The relatively low number of non-surgical cases can be attributed to the fact that this is a quaternary care outpatient clinic, where cases with higher surgical potential are referred from other pediatric clinical specialties.

Therefore, PPS can contribute to surgical decision-making even in cases of bilateral UPJO.

High scores are predictive of surgery, and low scores guide expectant management. However, an intermediate-risk score necessitates continued clinical monitoring and serial radiological assessments. The PPS is, therefore, a tool to help predict outcomes, but it does not replace individualized clinical assessment. Studies with larger samples may further clarify the potential for using this ultrasound-based scoring system, especially in intermediate-risk cases.

Conclusion

PPS helps the clinical practice of UPJO due to its high sensitivity in high and low scores, requiring an

Table 3 Correlation of PPS of surgical cases and DMSA scan (SNDRF = supra-normal differential renal function.

PPS	DMSA			
	Normal	Abnormal	SNDRF	Total
Low	0	1	0	1
Intermediate	2	3	3	8
High	2	9[a]	9	20[b]
Total	4	12	12	28

[a] 1 case of ipsilateral functional exclusion.
[b] 1 case without data.

individualized clinical and radiological assessment in intermediate-risk cases.

Ethical approval

This work was approved by the ethics committee (0436/2022).

Funding source

None.

Conflict of interest

None.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jpurol.2025.07.033.