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Original Article

Renal Calyx to Parenchymal Ratio (CPR) versus Anteroposterior Pelvic Diameter (APD) in Predicting Outcome of Pyeloplasty for Uretero-Pelvic Junction Obstruction

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Abstract

Background: After surgical correction of Ureteropelvic junction obstruction (UPJO) follow up is commonly performed by anteroposterior diameter (APD) of renal calyx in ultrasonogram and by GFR and deferential renal function (DRF) renogram. The aim of the study was to find out the accuracy of renal calyx to parenchyma ratio (CPR) and APD to predict outcome after pyeloplasty.

Methods: This prospective comparative study was conducted on children age 0 to 12 years with unilateral UPJO. APD and CPR in USG and Glomerular Filtration Rate (GFR), Differential Renal Function (DRF) with graph in renogram was selected as the predictor of surgical outcome of pyeloplasty. All the data were collection in 3 occasions: preoperative, at 3rd month and at 6th month after surgery.

Results: Among 20 patients, mean age was 4.72 (± 2.74) years. Difference between preoperative and postoperative 6th month of CPR (ΔCPR) and percentage change of difference between preoperative and postoperative 6th month of CPR(%ΔCPR) strongly predicted successful pyeloplasty with a higher sensitivity (85.7% and 21.4%) respectively. In contrast difference between preoperative and postoperative 6th month of APD (ΔAPD) and percentage change of difference between preoperative and postoperative 6th month of APD (%ΔAPD) predict successful pyeloplasty with a sensitivity of (42.9% vs 78.6%) and difference between preoperative and postoperative 6th month of DRF (Δ DRF) and percentage change of difference between preoperative and postoperative 6th month of DRF (%Δ DRF) predict successful pyeloplasty with a sensitivity of (57.1% vs 57.1%).

Conclusion: CPR can predict the surgical outcome of pyloplasty like APD, DRF and GFR; and should be assesses during follow up.

Key words: Anteroposterior diameter, Differential Renal Function, Glomerular Filtration Rate, Pyeloplasty, Renal calyx to parenchyma ratio, Ureteropelvic junction obstruction.

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Introduction

Ureteropelvic junction obstruction (UPJO) is the commonest cause of pediatric hydronephrosis occurring in 1 in 1000-2000 live births. [1] The goal of the surgery is to improve renal drainage and to maintain or improve renal function. [2] Pyeloplasty is gold standard procedure and 98% of patients had improvement in the renal dilatation and excretion pattern after the procedure. [3] After pyeloplasty, assessment of HN grade through renal US scans can aid decision making, evaluation and surgical or pharmacological planning to prevent the progression of HN and renal function deterioration.[4]

Anteroposterior pelvic diameter (APD) is most popular and accepted parameter used to assess the degree of hydronephrosis.[5] APD has several shortcomings, such as changing with hydration status of the patient, greatly affected by the degree of reduction of pelvis done during pyeloplasty or remaining unchanged despite relief of obstruction. Therefore, there is a need for an alternative parameter that is reflective of functional status and, at the same time, aid in decision making and follow up. Imaji, and Dewan hypothesize that the calyx to parenchyma ratio (CPR) may act as that alternative parameter. CPR is the ratio of the depth of the calyx and parenchymal thickness in a hydronephrotic kidney.[6]

As resolution of parenchymal thickness after pyeloplasty is relatively fast and does not depend upon the extent of reduction of pelvis in pyeloplasty, the change in CPR, i.e., ΔCPR as a strong predictor of surgical outcome, but it is also a better predictor than ΔAPD.[5] Under this circumstance, to find out the efficacy of CPR and APD in ultrasound as an outcome predictor after pyeloplasty, a prospective comparative study has been conducted.

Materials and Methods:

Study settings

It was a Prospective longitudinal study carried out from March 2022 to February 2024 (28 months). Patients of unilateral UPJO, less than 12 years of age, admitted for pyeloplasty were included in this study. Patients with. Bilateral UPJO, associated vesicourtertic junction obstruction or vesicoureteric reflux, history of renal surgery or pyeloplasty and pyonephrosis with nephrostomy were excluded. Ethical clearance was taken from institutional ethical review committee. The aim of the study was to evaluate the role of renal CPR and APD to predict outcome after pyeloplasty. The pre- and post-operative CPR and APD in ultrasonogram (USG), the pre- and post-operative differential renal function and the sensitivity and specificity of CPR & APD as an outcome predictor were analysed. Key variables were renal parenchymal thickness, maximum calyceal dilatation, CPR and APD in USG, and DRF, GFR, Curve pattern and Outcome in renogram.

Study Procedure

24 patients were selected consecutively according to inclusion and exclusion criteria after consenting. Aims, objectives, procedures, risks and benefits of the study were explained to the parents of the patient. All children were evaluated with an USG and renogram (Technetium-99 Diethylenetriaminepentacetate, DTPA scan) before surgery and 6 months after pyeloplasty. By using US method APD, depth of calyx and parenchymal thickness was measured preoperatively and post-operatively after 3 months and 6 months by single sonologist. The calyx with the maximum dilatation was selected for calyceal depth and the corresponding parenchymal thickness was noted in the most representative and comparable view in both the scan. CPR was calculated from calyceal depth and parenchymal thickness.

Renogram (DTPA scan) was done with F-12 protocol before and 6 months after surgery. Interpretation of the renal scan involves evaluation of dynamic scan and inspection of time activity curves for each kidney. Graphical drainage pattern, GFR and differential function of the involved kidney on renogram was recorded. Obstructed curve was defined by considering renogram curve (rising/plateau curve). All the surgeries were performed by single surgeon. Anderson-Hynes pyeloplasty with reduction of the size of the pelvis was performed as indicated.

Data Collection & Analysis

For analyzing the data, the continuous variables (APD and CPR) was taken to explain the outcome. The outcome variable was categorized as successful, failed, based on combination of findings in the postoperative renography which includes renogram curve pattern, change in DRF and the dynamic serial images. A successful outcome as defined as a postoperative renogram that showed change in curve pattern from rising to down-sloping curve pattern and or increase in DRF more than 5%. A failed outcome was defined as a persistently rising curve, fall in DRF more than 5%. Data collection instruments included pre-tested semi-structured case record form that included socio demographic information, physical examination, and investigation profile including USG and Renogram findings. Technetium-99 m Diethylenetriaminepentacetate (DTPA) isotope used for renal scan (DTPA scan). PHILIPS Ultrasound System Affinity 50 G, country of origin: USA, year: 2014 for USG measurement. Urine C/S and R/E was done in microbiology lab. Physical examination of BP measurement needed stethoscope and BP cuff. Among 24 cases, 4 patients were lost during study period and total sample size became 20.

Data were entered, cleaned and re-coded using Statistical Package for Social Sciences (SPSS) version 23.

Missing data were checked through frequency run. The numerical data were expressed as mean with standard deviation. The categorical data were expressed as number and percentage and were compared by chi-square test. 95% confidence intervals (CI) were calculated for these values. Receiver operating characteristics (ROC) curves was constructed to evaluate the ability of CPR and APD to predict surgical outcome after pyeloplasty. Statistical significance was set at $p<0.05$.

DRF is a measurement of each kidney's ability to extract tracer from blood and therefore reflects renal function.[7] DRF in the 45–55% range is regarded as normal. CPR is the ratio of the depth of the calyx and parenchymal thickness measured on ultrasound (USG) in coronal image.[5] Obstruction of the urinary outflow causes backpressure changes in the renal calyx with thinning of the parenchyma. The backpressure changes usually reverse following removal of the obstruction and is reflected in the CPR. [6]

Here,

- ΔCPR = (Pre Op CPR - Post Op CPR)
- % ΔCPR = {(Pre Op CPR - Post Op CPR)/ Pre Op CPR} x100

Outcome was categorized into success, failure. Success was defined when on renogram showed change in curve pattern from rising to down-sloping curve pattern and or increase in DRF more than 5%.

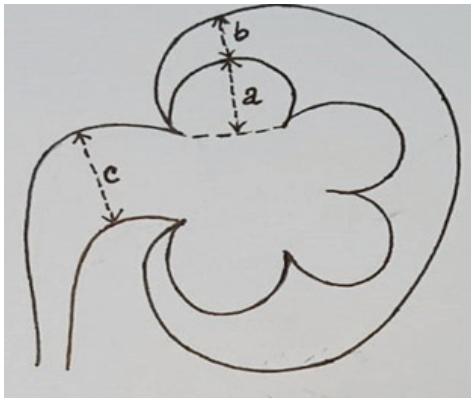


Figure 1.1: Schematic diagram showing measurement of calyceal depth and parenchymal thickness in a hydronephrotic kidney, Here a- depth of calyx, b- parenchymal thickness and c – Antero-posterior trans pelvic diameter.

Results

Mean age was 4.72 (± 2.74) years with a range from 5 months to 10 years. UPJO was found five times higher in males than females. Mean parenchymal thickness of kidney was 0.69 (± 0.4) cm preoperatively ranging from 0.20 to 1.63 cm. Mean parenchymal thickness in 3rd month after operation was 0.91 (± 0.4) cm and in 6th month was 1.05 (± 0.3) cm (figure 2).

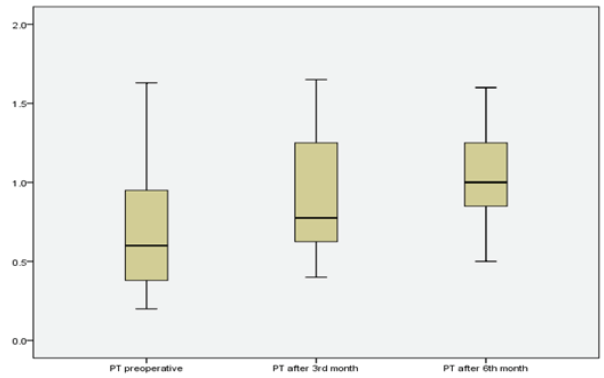


Figure 2: Box & plot diagram showing distribution of parenchymal thickness of UPJO patients

Mean of parenchymal thickness difference between 3rd months to preoperative period was 0.21 (± 0.3) cm. Mean of parenchymal thickness difference between 6th months to preoperative period was 0.35 (± 0.4) cm.

The mean MCD of the kidney was 2.76 (± 1.9) cm preoperatively ranging from 1.00 to 9.31 cm. The mean maximum calyceal dilatation after 3rd month was 1.90 (± 0.9) cm and after 6th month was 1.39 (± 0.6) cm (Figure 3).

The mean of maximum calyceal difference between the preoperative period to 3rd months was 0.87 (± 1.5) cm. The mean of maximum calyceal difference between the preoperative period to 6th months was 1.37 (± 1.4) cm

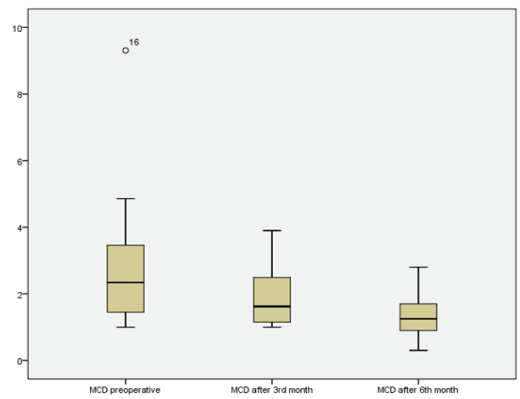


Figure 3: Box & plot diagram showing distribution of maximum calyceal dilatation of UPJO patients

The mean of APD was 5.52 ± 3.0 (ranging 1.70 to 12.20 cm) preoperatively. The mean APD after 3rd month of pyeloplasty was 2.69 ± 1.2 (ranging 0.5 to 6.4 cm) and after 6th month, it was 2.41 ± 0.6 (ranging 1.2 to 4.20 cm). The mean change between the value of 3rd and 6th month of APD, was 0.28 (10.4%). Mean changes between the value of APD preoperative and 3rd were 2.83 (51.27%). Mean changes between the value of APD preoperative and 6th months were 3.11 (56.34%).

Table 1: Changes of Anteroposterior diameter (APD) of renal pelvis and Calyx to parenchyma ration (CPR) in UPJO patients (n=20)

	APD Mean±(SD)in cm	CPR Mean±(SD) in cm
Preoperative	5.52 (± 3.0)	5.58 (± 6.05)
3rd month	2.69 (± 1.2)	2.53 (± 1.62)
6th month	2.41 (± 0.6)	1.43 (± 0.75)
Mean changes (%) (between 3rd and 6th month)	0.29 (10.8%)	1.01 (43.59%)
Mean changes (%) (between preoperative & 3rd month)	2.83 (51.2%)	3.05 (54.72%)
Mean changes (%) (between preoperative & 6th month)	3.11 (56.34%)	4.15 (74.46%)

The mean of CPR was 5.58 (ranging from 1.04 to 25.86 cm) preoperatively. The mean of CPR after 3rd month was 2.53 (ranging from 0.61 to 6.4 cm) and after 6th month was 1.42 (ranging from 0.27 to 3.20 cm). CPR difference between 3rd month to 6th month was 43.59%. CPR difference preoperative and 3rd were 54.72%. CPR difference preoperative and 6th months were 74.46% respectively.

The preoperative mean of glomerular filtration rate was 72.27 ml/min/1.73m2 (ranging from 18.7 to 147.7 ml/min/1.73m2). The mean of glomerular filtration rate at 6th months was 77.65 ml/min/1.73m2 (ranging from 6.8 to 147.2 ml/min/1.73m2). Mean changes of GFR values between postoperative and after 6th month was 7.44%. The mean of DRF before operation and 6th month was 45.45 (± 13.15) and 45.75 (± 11.76), respectively. All the patients curve pattern was uprising in preoperative state. In post-operative state 10% patients showed uprising pattern during 6th month of follow up.

Outcome of pyeloplasty was classified into success, failure and equivocal. There was no patient with equivocal outcome. Among 20 patients, majority patients (90%) had successful outcome. Rest 10% patient's outcome categorized as failure.

In DRF, Supranormal differential function is considered to exist when DRF in the affected kidney is more than 55% of the total renal function. In this study, four (4) patients showed supra normal renal function. Therefore, during analysis and comparison of APD, CPR, and DRF those 4 patients were excluded. Rest 16 patients were analyzed for ΔAPD, ΔCPR, ΔDRF and their percentage change. All these variables were estimated by difference between preoperative value and value after 6th month follow up.

There was strong association found between ΔAPD and Δ CPR which was statistically significant. In contrast, there was no association found between ΔCPR and ΔDRF.

Moderate association was found between ΔDRF and Δ GFR. Inverse relationship was found between ΔCPR and ΔGFR but it was not statistically significant (Table 2).

Table 2: Correlation among ΔAPD, ΔCPR, ΔGFR and ΔDRF

Characteristics	Correlation coefficient(r)	P value
Relationship between ΔAPD and ΔCPR	0.78	p=0.00
Relationship between ΔDRF and ΔCPR	0.02	p=0.94
Relationship between ΔGRF and ΔCPR	-0.32	p=0.24
Relationship between ΔDRF and ΔGFR	0.55	p=0.03
Relationship between ΔAPD and ΔGFR	-0.42	p=0.87
Relationship between ΔAPD and ΔDRF	0.06	p=0.81

In this study, there was no equivocal outcome after pyeloplasty surgery. Therefore, the study surgical outcome (successful and failure) become the dependent variable. Percentage of ΔAPD, ΔCPR, ΔDRF, ΔGFR as independent predictor of the outcome was measured with dependent variable of surgical outcome. Additional binary logistic regression with individual model of several parameter was measured to compare the outcome. The individual model ΔAPD, ΔCPR, ΔDRF were predicted. In contrast, ΔAPD have similar accuracy 87.5 like ΔCPR model (Figure 4). ΔDRF correctly predict the 50% failure and 100% successful cases with overall outcome 95% accuracy. ΔGFR predicts 2 failure and 14 successful outcome with 100% correct and overall accuracy gained 100%.

Among percentage changes of ΔAPD, ΔCPR, ΔDRF and Δ GFR were estimated. Between ΔDRF and ΔGFR in renogram, ΔGFR shows overall accuracy of 100% with compared to ΔDRF model showed 93.8% accuracy. Both ΔAPD and ΔCPR model shows similar accuracy of 87.5%.

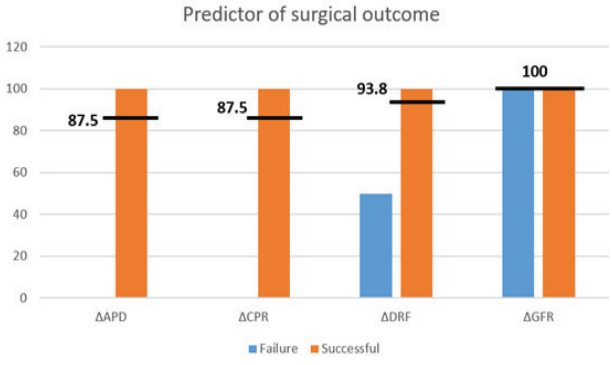


Figure 4: Graphical representation of percent changes of parameter as predictor of surgical outcome

Mean changes of ΔAPD, ΔCPR, ΔDRF and ΔGFR were analyzed to find out the sensitivity and their specificity. Through the ROC curve both ΔCPR and ΔAPD showed higher specificity of 100% but ΔAPD had better sensitivity than ΔCPR. In contrast, though renogram is standard test for renal function. But in this study ΔDRF had sensitivity of 57.1% where ΔGFR showed highest sensitivity of 78.6%. All of these parameters did not show any significant p value (Figure 8). In this curve, the gold standard showed better result. There was reduction of APD during pyeloplasty. Therefore, ΔAPD showed better AUC than ΔCPR.

ROC curve is also used to analyze the %ΔAPD, %ΔCPR, %ΔDRF and %ΔGFR. Among these parameters %Δ GFR has significant p value but no specificity. %ΔAPD has sensitivity 78.6% and specificity of 50% which corresponds to the reference line with highest AUC 0.625. %Δ DRF also shows the sensitivity of 57.1% with specificity 50%. Highest sensitivity (85.7%) was found in %ΔCPR with a specificity of 50%. Among these variables no statistical significance was not found (Figure 9). Here, %ΔCPR shows highest sensitivity but AUC is lesser than %ΔAPD. Operative resection of APD results better outcome of %Δ APD change than %ΔCPR (Table 3).

Table 3 Summary of ROC analysis of %ΔAPD, %ΔCPR, %ΔDRF, %ΔGFR, (n=16)

Parameter	Cut off value	Sensitivity	Specificity	AUC	95%CI	p value
%ΔAPD (preop -6th month)	44.75	78.6	50	0.62	0.31-0.94	0.58
%ΔCPR (preop -6th month)	54.91	85.7	50	0.54	0.06-1.0	0.87
%GFR (preop - 6th month)	1.57	0.71	100	1.0	1.0-1.0	0.02
%DRF (preop - 6th month)	1.43	57.1	50	0.68	0.21-1.0	0.43

Discussion

The purpose of imaging after pyeloplasty is to confirm relief of obstruction, resolution of hydronephrosis, and early identification of any persisting obstruction. Renograms are considered the gold standard, but has been challenged due to their invasive nature, availability and risk of radiation exposure. Ultrasound is safe and non-invasive and can be used to identify successful outcomes after pyeloplasty. Parameter like APD has affected by hydration status and the impact of the amount of reduction pyeloplasty. In contrast, CPR may be a useful tool in postoperative follow-up as it is unaffected by patient hydration, the amount of pelvis excised, and has no radiation risk.

By using ultrasonography pre and post-operative parenchymal thickness, APD, and CPR can be measured. The improvement of APD in the renal pelvis acts as a good predictor of successful pyeloplasty. According to Kis, E., et. al. renal pelvis decreased by only 76% of cases with UPJO patients who underwent pyeloplasty after one year of surgery.[8] They concluded that pelvic dilatation improvement is much slower than the increase of renal parenchyma within one year of surgery. They suggest persistent dilatation represents the slow resolution of previous dilatation, not a failure of surgery. So APD might have less value in follow-up after pyeloplasty. Imaji and Dewan compared pre and post-operative measurement of hydronephrosis by using SFU grading and CPR in children who underwent pyeloplasty.[6] They concluded that CPR can measure the changes in pre and post-operative conditions of hydronephrosis where SFU grading has no significant difference. El-Desoukey found parenchymal thickness and renogram as good predictors of pyeloplasty outcome.[1] Their study included APD and parenchymal thickness as an ultra-sonographic parameter. They found a significant progressive reduction in post-operative follow-up APD at 3rd and 6th months. They concluded that an increase in parenchymal size and thickness represents an improvement in renal tissue. Sarhan et al. confirmed the improvement of APD in the renal pelvis acts as a good predictor of successful pyeloplasty.[9] Romao et. al. and Rickard et. al. suggested the percentage change of APD as a good predictor of the surgical success of pyeloplasty and guide post-operative monitoring [10,11] Almodhen et. Al. found that CPR correlates very well with post-operative hydronephrosis changes and can predict the success and follow up of pyeloplasty.[12] Measurement of CPR is easy, does not need any complicated software or specific equipment. CPR can also be used in surveillance technique to identify the UPJO and predicts the need for pyeloplasty. Babu and Sai found lack of correlation with radionuclide findings.[13] Improvement of renal condition on renogram is not uniform and often delayed. They concluded that parameters like APD, cortical thickness (CT) take longer to recover in pyeloplasty where CPR usually recovers early and show correlation.

In our study, we compared two objective variables, APD and CPR, to identify the utility of each measurement in follow-up after pyeloplasty. We calculated the difference in APD (ΔAPD) and compared it with the difference in CPR (ΔCPR) in the preoperative and postoperative settings. In our study, ΔAPD was reduced in comparison to preoperative and post-operative follow-up of the 3rd and 6th month (51.27% vs 56.34%) in comparison to El-Desoukey et. al. (40% vs 68%).[1] Gharpure et. al. found a significant change at the post-operative follow-up (54.42%).[5] APD changes were similar to other studies and more significant in the early post-operative follow-up than in the 6th-month follow-up. There was an early reduction in APD due to a moderate reduction of renal pelvis during surgical procedures may have an impact on

the reduction in 3rd month follow-up. In CPR, it shows better outcomes in renal function. In our study, mean changes between preoperative to 3rd month shows significant changes from preoperative which were similar to Gharpure et. al., (54.72% vs 56.81%). At the end of 6th month ΔCPR shows changes up to 74.46%. Rickard et. Al suggested that 40% of changes in % ΔAPD post-operative follow-up strongly predict pyeloplasty success.[11] In our study follow-up shows 51.27% in the 3rd month and 56.34% in the 6th month. In measuring the DRF, there was very little change in post-operative follow-up (0.64%) whereas Gharpure et. al showed a 5.39% change.[5] In our study, four cases had supranormal renal function which had an impact on the mean changes of DRF. Additionally, we measured GFR which showed an improvement in mean changes of renal function about 7.4%.

In logistic regression analysis, the individual models Δ APD, ΔCPR, ΔGFR and DRF were predicted. In contrast, ΔAPD has a similar accuracy of 87.5 like the ΔCPR model. ΔDRF had a 93.8% accuracy. ΔGFR had accuracy of 100%. However, all the parameters failed to find the significance in the regression analysis.

Using ROC curve analysis, we observed that ΔCPR and % ΔCPR predicted successful pyeloplasty with a higher sensitivity (21.4 and 85.7% respectively) with cut-off values of 3.91 and 54.91 % respectively. In contrast, Δ APD and % ΔAPD, predict successful pyeloplasty (42.9% vs 78.6%) with a cut-off value of 3.5 and 44.7% respectively. In case of renogram, ΔDRF and % ΔDRF predict successful pyeloplasty (57.1 vs 57.1) with a cut-off value of 0.6 and 1.43% respectively. This indicates, the ΔCPR and % ΔCPR as a parameter in follow-up ultrasound after pyeloplasty can be done. ΔCPR and % ΔCPR is not influenced by operator variability in terms of pelvic reduction. ΔAPD and % ΔAPD shows the better sensitivity and lower predictive accuracy of in identifying successful pyeloplasty but input varies by dilation. Reduction in surgical procedure of APD gives better outcome than others. These lower predictive accuracy means that these children may be subjected to repeated imaging which results in added treatment costs and anxiety and stress to the parents. Therefore, to avoid this undesirable scenario in clinical settings; ΔCPR and % ΔCPR can be used and highlights the need for an alternative parameter. Moreover, other studies showed that hydration status affects APD but does not influence the results of CPR.

This study had been conducted in single institution. Short-term follow-up period and the requirement to evaluate its long-term prediction accuracy are further limitations. In order to limit the observation bias, sonographic findings were standardized and reviewed by a senior sonologist. Renogram graph findings were reviewed by the expert radiologist. Review of the sonographic and radiological findings by expert became the strength of the study. The pyeloplasty was done by single surgeon which ensures the management of UPJO remains unified. Further studies can validate its finding. Long term follow-up will be needed to find out the best point where CPR will show the highest accuracy for predicting the outcome of pyeloplasty.

Conclusion

CPR is a surgeon independent parameter. Renal calyceal depth and parenchymal thickness is not altered directly during the surgery. Therefore, CPR had the advantages in comparison to APD whereas pelvis gets excised during reduction pyeloplasty. Although renogram is gold standard, ununiform improvement is the major drawback of renogram which is also evident in our findings. Therefore, CPR can be used as successful predictor for the outcome of pyeloplasty in patients with hydronephrosis presented with UPJO.

Ethics approval and consent to participate: Ethical clearance was obtained from Institutional Review Committee (IRC) of Chittagong Medical College and Hospital (Memo no- 59.27.0000.013.19PG.009.2023/955), consent for participation taken grom guardians and the study was conducted according to Helsinki declaration.

Consent for publication: Data were published anonymously, so consent for publication was not necessary.

Availability of data and material: Data are available upon reasonable request from corresponding author.

Competing interests: None

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References

1. El-Desoukey, M.S., Khalil, S.A., Salem, E.A. and Seleem, M.M. Role of Renal Parenchymal Thickness and Renal Isotope Scan in Predicting Outcome After Pyeloplasty in Children with Ureteropelvic Junction Obstruction (UPJO). The Egyptian Journal of Hospital Medicine. 2021; 82(2): 329-334.
2. Siddique, M., Pansota, M.S. and Saleem, M.S. Outcome of pyeloplasty in children. Journal of Ayub Medical College Abbottabad. 2014; 26(1):71-75.
3. Pohl, H.G., Rushton, H.G., Park, J.S., Belman, A.B. and Majd, M. Early diuresis renogram findings predict success following pyeloplasty. The Journal of urology. 2001;165(6-2): 2311-2315.
4. Han, J.H., Song, S.H., Lee, J.S., Nam, W., Kim, S.J., Park, S. and Kim, K.S. Best ultrasound parameter for prediction of adverse renal function outcome after

pyeloplasty. International Journal of Urology. 2020; 27(9):775-782.

5. Gharpure, K.V., Jindal, B., Naredi, B.K., Krishnamurthy, S., Dhanapathi, H., Adithan, S., Kumaravel, S. and Govindarajan, K.K.,. Calyx to Parenchymal Ratio (CPR): An unexplored tool and its utility in the follow-up of pyeloplasty. Journal of Pediatric Urology. 2021;17(2):234-e1.
6. Imaji, R. and Dewan, P.A., Calyx to parenchyma ratio in pelvi-ureteric junction obstruction. BJU international. 2002; 89(1):73-77.
7. Brink, A., Libhaber, E. and Levin, M. Renogram image characteristics and the reproducibility of differential renal function measurement. Nuclear Medicine Communications. 2021;42(8):866.
8. Kis, E., Verebély, T., Kövi, R. and Máttyus, I.,. The role of ultrasound in the follow-up of postoperative changes after pyeloplasty. Pediatric radiology. 1998;28:247-249.
9. Sarhan, O., Helmy, T., Abou-El Ghar, M., Baky, M.A., El-Assmy, A. and Dawaba, M.,. Long-term functional and morphological outcome after pyeloplasty for huge renal pelvis. BJU international. 2011107(5):829-833.
10. Romao, R.L., Farhat, W.A., Pippi Salle, J.L., Braga, L.H., Figueroa, V., Bägli, D.J., Koyle, M.A. and Lorenzo, A.J. Early postoperative ultrasound after open pyeloplasty in children with prenatal hydronephrosis helps identify low risk of recurrent obstruction. The Journal of urology. 2012.; 188(6):2347-2353.
11. Rickard, M., Braga, L.H., Oliveria, J.P., Romao, R., Demaria, J. and Lorenzo, A.J. Percent improvement in renal pelvis antero-posterior diameter (PI-APD): prospective validation and further exploration of cut-off values that predict success after pediatric pyeloplasty supporting safe monitoring with ultrasound alone. Journal of Pediatric Urology. 2016;12(4):228-e1.
12. Almodhen, F., Moneir, W.M., Bashareef, A., Al-Zahrani, A., Alaqeel, A., Alhams, A., Jamalalail, Y., Burki, T. and AlShammari, A.. Postnatal Calyceal-to-Parenchymal Ratio: A Promising Predictor for Surgical Correction of Ureteropelvic Junction Obstruction in Newborns. Cureus. 2023; 15(11): e48466. doi:10.7759/cureus.48466.

Babu, R. and Sai, V., Pelvis/cortex ratio: an early marker of success following pyeloplasty in children. Journal of Pediatric Urology. 2010; 6(5):473-476.