Journal of Public Health & Environment (2024)

Journal of Public Health & Environment

journal homepage: www.journal-phe.online

Paper Type: Original Article

The effect of pyeloplasty age on postoperative renal function and antero-posterior diameter (APD) in prenatally diagnosed Ureteropelvic junction Obstruction：Indications for the timing of pyeloplasty

Yan Liang[1]，Hua Xie[1]，Xiaoxi Li[1]，Yichen Huang[1]

1.Department of Urology, Shanghai Children' Hospital，school of medicine, Shanghai Jiaotong University, China.

FUNDING INFORMATION

Youth Project Fund of Shanghai Municipal Commission of Health and Family Planning（20184Y0034）

Abstract

OBJECTIVE

To evaluate the renal function and percent improvement in the antero-posterior diameter (PI-APD) outcome in different operation age for ureteropelvic junction obstruction (UPJO) with antenatal diagnosed .

PATIENTS AND METHODS

* A retrospective review cases that under 3 years who underwent pyeloplasty from 2011 to 2015 for UPJO with prenatally diagnosed in single centre. All patients were underwent and recorded renal ultrasonography and diethylene triamine pentaacetic acid (DTPA) scans for preoperative and postoperative. Anderson-Hynes dismembered pyeloplasty was carried out for all cases.

* Records were evaluated with respect to age at operation, preoperative antero-posterior diameter (APD), preoperative split renal function（SRF）and postoperative course.

*Considered the PI-APD>40% or SRF was improved by >5% whose underwent pyeloplasty is improvement, analyzed improvement and un-improvement patients' age.

RESULTS

* In the period 2011 to 2015, 49 cases aged <3 years of prenatally diagnosed UPJO underwent dismembered pyeloplasty with clinic date completion in our centre.

* Of these patients, male (n=46, 94%) and female (n=3, 6%) were in our study, from 1 month to 36 month, with the median age of 3.8 months. Follow-up time ranged 6 to 12 months.

* A statisitically significant different between before and after operation APD(P=0.000) or SRF(P=0.046) under the

Wilcoxon rank sum Tests. There was a significant negative correlation between the age of surgery and PI-APD (R=-0.340, P=0.017). And significant negative correlation were observed between the age and improvement SRF>5% (R=-0.382, P=0.007)

* 5 patients underwent redo double –J stent cathelerization because hydronephrosis aggravate in follow-up. The overall success rate was 89.7%.

CONCLUSIONS

* The age of pyeloplasty maybe a factor to outcome for spilt renal functional and PI-APD.

* Once a UPJO patient has a operation indication , allow appropriate early time for under surgery intervence is necessary.

Keywords: Antenatal hydronephrosis, children, pyeloplasty, outcomes, operation ages

Introduction

Dilation of the fetal renal collecting system, antenatal hydronephrosis (ANH), is one of the most common abnormalities detected on prenatal ultrasonography (US), reported in approximately 1-5% of all pregnancies [1]. AHN represents a wide spectrum of urological conditions, ranging from transient dilation of the collecting system to clinically significant urinary tract obstruction or vesicoureteric reflux (VUR) [2] , Ureteropelvic junction obstruction (UPJO) is the major cause for hydronephrosis, followed by vesicoureteral reflux(VUR) ,obstructive megaureter and ureterocele, almost parts of UPJO patients were diagnosed prenatally. Hydronephrosis now is usually diagnosed antenatally and affects approximately 1 in 1500 live births [3]. It was reported that congenital urinary tract malformation disorders account for about 30% of all prenatally diagnosed anomalies [4], which UPJO was the first. Many societies with fetuses and children with UPJO, for example the Society for Fetal Urology (SFU), the American Society of Pediatric Nephrology (ASPN), the Society for Pediatric Urology (SPU) [5] made difference classification standards and treatments. The rule management for fetal hydronphrosis need disciplinary ultrasound of urology system after postnatal. Ramiro et al. reported that low-grade hydronephrosis diagnosed within the first year of life remains stable or improves in 97.4% of renal units, and SFU grades 1-2 usually need not surgery that antibiotic prophylaxis has a limited role in management [6]. During the antenatal period, ultrasounography is preformed to assess any associated abnormalities and to measure bladder volume, kidney size, and APD of the renal pelvis. The most sensitive time for urinary tract evaluation is 28 week[3]. Diuretic renography is the most commonly used diagnostic tool to assess for obstruction. Weather the age of surgical impact on outcome, should the doctor need do surgical as soon as possible, there has different points. Thus, our study retrospective cases which patients surgical in different age, and analyze ages to the outcome for APD and renal function. The aim of this study was to independent postnatal predictors of surgery outcome, and secondary aim was to identify predictors of surgery.

Patients and Methods

We performed a retrospective review of patients who underwent surgical with diagnosed ANH at our hospital between January 2011 and September 2015. Medical records were evaluated with respect to age at operation, gender, affected sides, both preoperative and postoperative ultrasonography and renal function, surgical details, and postoperative course. In our study, all patients with ureteral stents after pyeloplasty, and removed stents

within 6-8 weeks. Only case underwent with primary unilateral hydronephrosis were included, renal ultrasonography and diuretic renogram definite the UPJO, whereas children with bilateral UPJO, vesicoureteral reflux (VUR), and duplex system were excluded from the study. We depart these patients into two parts to evaluate outcome: part 1 considered PI-APD>40% has a good outcome, part 2 considered the improvement of SRF>5% has a good outcome . In this study pyeloplasty was performed whenever there was deterioration in SRF>10%, or SRF<40%, APD>20mm or urine infection or pain during the follow-up.

Preoperative radiology included renal ultrasound, magnetic urography (MRU) and diuretic renography for all patients. Renal ultrasound was measured APD and PT, DTPA scans were preformed preoperatively and 6months-12months after surgical to evaluate drainage and assess renal function.

Date were collected and processed using SPSS, version 20. Median and quartiles deviation are expressed for data, Wilcoxon rank sum test was used to compare the APD and SRF before and after pyeloplasty, Pearson correlation analysis was used to analyze the relationship between continuous variable PI-APD and operative age, and Spearman correlation was used to analyze the relationship between the improvement of renal function and the age of operation. Chi-square for categorical data which analyze the relationship between the age with improvement and un-improvement patients . P values <0.05 were considered to be significant.

Results

Between January 2011 and September 2015, our center admitted 160 patients who diagnosed prenatally UPJO with Anderson-Hynes dismembered pyloplasty treatment. Respective 49 unilateral UPJO patients under 3 years old that followed up intimately. Detailed account of the patient data is summarized in Table 1.

TABLE 1 Demographic and operative data of the initial intervention

variables	patients n(%)
Gender	
Boy	46 (94.1)
Girl	3 (5.2)
Age	
1-3 month	24 (49)
4-6 month	8 (16)
7-12 month	12 (24)
13-36 month	5 (11)
Affected side	
Right	12 (24.5)
Light	37 (75.5)
spilt function(%)	38.06(32.79, 45.5)
APD	34(23.6, 38.5)
PT	3.9(2.6, 4.65)

The age ranged 1 month to 36 month, and average is 6.7 month, the median age is 3.8 month. The age of operation was mainly within 1 years of age (44 cases, 89.8%),

among which 1-3 months (24 caese) accounted for 54.5%, of children aged 1 years old. Among these case, there were 9 cases underwent nephrostomy because hydronephrosis or SRF is more serious. We found that the APD, SRF are improve than preoperative.

TABLE 2 The data of before and after pyeloplasty

	before	after	p
APD (mm)	34(23.6, 38.5)	13.4(7.9, 18.5)	*0.000*
SRF (%)	38.06(32.79, 45.5)	44(37.5, 46.99)	*0.046*

Table 2 provides a detailed account data with before and after pyeloplasty for APD and SRF. Wilcoxon rank sum test showed that the difference of APD value (P=0.000) and renal function value(P=0.046) before and after operation were statistically significant. There was a negative correlation between the operative age and the Pearson correlation analysis of the PI-APD (p=0.017, the correlation coefficient was -0.340). The Spearman correlation analysis SRF>5% was also negatively correlated with the operative age of the children (P=0.007, the correlation coefficient was -0.382). The improvement of PI-APD and the improvement of renal function was shown in Table 3. The common improvement was 17 cases, and the common non improvement was 9 cases. Chi-square test showed that the difference between the two groups was statistically significant (P=0.348).

TABLE 3 The improvement of the difference between PI-APD and SRF

		PI-APD		
		Non-improvement	Improvement	*Total*
SRF	Non-improvement	9	19	30
	Improvement	4	17	19
Total		*13*	*36*	*49*

According to the PI-APD, the effect of surgical treatment was judged. The operation of PI-APD > 40% was improved, and PI-APD was less than 40% considered non-improvement . Among the 49 children, 36 were improved, 2.8 (1.85, 6), and 13 were not improved, 10 (2.7, 18.5). The independent sample Mann-Whitney U test was used to analyze the difference between the improved children and the non improved children (P=0.022). Figure A is the ROC curve of PI-APD and operative age (the area under the curve is 0.715, 95%CI 0.526-0.904). It is suggested that the sensitivity of the improved operation is 69.2% and the specificity is 77.8% when the operative age is 6.5 months.

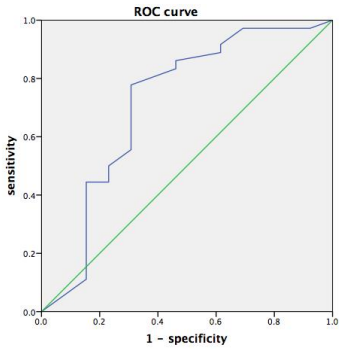

Figure A between age and PI-APD

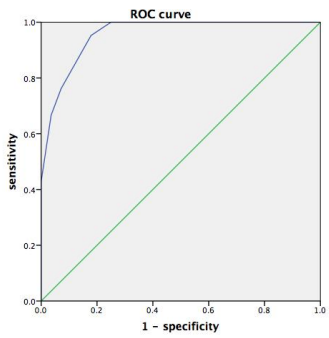

Figure B between age and SRF

The effect of surgical treatment was judged by the improvement of spilt renal function.

It was considered that the improvement of renal function difference was more than 5%, and the improvement was less than 5%. Of the 49 children, 21 were improved, 2 (1.1, 4.9), and 28 were not improved, (2.1, 10.75). The difference was statistically significant (P=0.008) using independent sample Mann-Whitney U test. Figure B is the ROC curve of the renal function difference and the age of operation (the area under the curve is 0.957, 95%CI 0.908-1.000). It is suggested that when the age of operation is 4.05 months, the sensitivity is 67.9% and the specificity is 76.2%. If the improvement of renal function > 10%, there was no significant difference between the improvement group and the un-improvement group (P=0.175).

There are 5 patients underwent redo surgery, because APD or PT get worse, and the success rate is 89.7%. In all of them, D-J stent reseted in three children, one underwent the nephrostomy, one redo dismembered pyloplasty after 1 years, one underwent the nephrostomy because of the failure with D-J stent reseted. Table 4 showed the characteristic for the redo patients.

TABLE 4 Characteristic for redo patients

	Age (month)	Pro-APD(mm)	Pro-PT(mm)	Redo interval time	Post-APD(mm)	Post-PT(m)	Redo surgery	After redo surgery 6 month APD(mm)	After redo surgery 6 month PT(mm)
1	7	47	4.5	5	50	2.9	N+P	17	3.3
2	11	39	4.2	4	56	2	C+N	18	5.7
3	7	23	5	6	60	6	C	8	6
4	1	65	2.6	2	46	5.9	C	16	3.8
5	2.4	60	3	4	40	3	C	20	4.3

Cathelerization=C; Nephrostomy=N; Pyeloplasty=P

Discussion

With the advent of ultrasonography in prenatal examination, and the system of antenatal examination become more completed, with pediatricians and urologists were confronted by an increasing number of babies and children with asymptomatic dilation of the upper urinary tract [7]. Prenatal diagnosis of urinary tract (UT) dilation occurs in 1-2% of all pregnancies. It is the common abnormality renal collecting system. Of the ANH pathologic, UPJO is the most common, it can lead to an increase in backpressure on the kidney, hydronephrosis, and progressive damage to the kidney function [3]. If the fetus was diagnosed ANH, it must be under the ultrasonography in regular intervals, so that the pediatric urologist could know the change for the hydronephrosis. In most centers, the APD as well as the presence of decreased function which have been considered the main parameters to indicate surgical correction. Some indications of operation for UPJO include <40% differential function of the hydronephrosis kidney on MAG3 scanning, a > 20mm anterior-posterior of the renal pelvis on ultrasonographic scan, pain, and infection [3],[7]. Dias evaluate the UPJO for detecting infants with prenatal hydronephrosis who need surgical intervention, obtain that 18mm for fetal renal pelvic dilation and 16mm for postnatal renal pelvic dilatation had the best diagnostic odds ratio to identify infants who need pyeloplasty [8]. In the present study, 109 patients for conservative management showed that 23.9% required operative intervention during follow-up, and APD of 24.3 mm could predict the need for surgery, with a sensitivity of 73.1% and a specificity of 88.0%, as reported by Arora et al. [9]. Anderson-Hynes has been considered to be the gold standard for the treatment of UPJO, since the first description of the dismembered pyeloplasty by Anderson and Hynes in 1949 for the management of retrocaval ureter [10]. The treatment can be used in long strictures, in

severe hydronephrosis, or in the presence of crossing vessels, the success rate belonged 82.6%-98%[11, 12], in our study the total rate is 89.7%. There is still a lot of controversy about the choice of the timing of the operation at home and abroad. Some scholars advocate early active intervention, which is beneficial to the restoration of the renal function and the renal parenchyma to the maximum[13, 14]. Other scholars believe that UPJO has the possibility of natural regression, and therefore advocates long-term follow-up or appropriate delay in surgical intervention. Although effective surgical treatment is beneficial to the relief of hydronephrosis and the recovery of renal function, recent reports on postoperative recovery are different.

Does pyeloplasty improve renal hydronephrosis and renal function recovery? In our study, we from two parts to evaluate the outcome for operation, the change for APD and SRF. Many articles analyses the age time of pyeloplasty for renal function, most of them divide the age accord to 1 year. In order to know the functional outcomes following early versus delayed pyeloplasty in SFU grade 3-4 PUJ obstruction, 126 patients was reported by Ramesh [15] in 2015. According to the parents' consent, early operation or delayed operation should be taken according to the parents' wishes for the same condition of hydronephrosis. In Ramesh's study, the average age of the early operation group was 2.8 months, and the average age of the delayed operation group was 12.5 months, pointed that early pyeloplasty in prenatally diagnosed SFU grade 3-4 PJU obstruction leads to significant improvement of SRF. On the other points, Chandrasekharam et al. [16] observed that in unilateral symptomatic UPJO patients were performed before 1 year of age showed significantly greater improvement, even the postoperative SRF reached normal levels (SRF>40%) in young group. Mayor[17] and Palmer[18] also believed that early operation was beneficial to the recovery of renal function after statistical analysis. In China, the same result that points. They analyzed 174 cause for AHN patients underwent pyeloplasty. According to the age of operation they divided those caess in four groups, it was found that the improvement of renal function was the most significant after 1-3 months of SRF > 40%, and the correlation between renal function recovery and operation age was significantly increased when SRF < 40%. The results suggest that it may be related to the growth and development stage of children under 1 years of age.

On the other hand, MacNeily et al. [19] reviewed 75 cases of unilateral pediatric ureteropelvic junction obstruction during the last 8 years, they found that the change in postoperative renal function were unaffected by the age, and does not support the concept that pyeloplasty for the isolated, unilateral UPJO should be performed early to avert loss or renal function. If we considered the change >5% is significance that the result shows us the operation age is a relevant factor to SRF, and the improvement of renal function was negatively correlated with the age of operation in children, and the age of the patients with renal improvement was generally less than that of non-improved children. When the age of operation was 4.5 months, the specificity and sensitivity of the improvement of renal function were the highest.

According to a randomized trial from Rickard re al., PI-APD >40% at the first post-operative visit is a useful indicator of pyeloplasty success [20]. In recent years, it has also been widely used as an important index in the treatment of hydronephrosis. Rickard[20] pointed that PI-APD cut-off of ≥40% at the first post-operative visit is a useful indicator of pyeloplasty success. This is why we consider PI-APD >40% is a better outcome for pyeloplasty, and found that age is a predict indicator for PI-APD. There was a negative correlation between the age of operation and the effect of treatment, and the age distribution in the improvement group and the non-improved

group was different. The age of the children in the improvement group was generally less than that of the non-improvement group. In the present study, further analysis showed that when the same surgical indications were given, children with early age were better than the older children in the relief of hydronephrosis after operation. From the ROC curve analysis, when the age of operation was 6.5 months, the sensitivity and sensitivity of operation were 69.2% and 77.8% respectively. Similar conclusions have been reported in China, but the specific pathophysiological reasons can not be explained. Kim[13], by analyzing the data of 36 cases of pyeloplasty, found that the improvement of renal parenchyma thickness in children aged 1 years was better than that of children aged 1 years old, and the results of our analysis were also supported.

From the results of this study, we can see that the APD and the improvement of renal function are all negatively related to the age of the patients, and further suggest that the surgical treatment effect of the children of early age is better than that of the older children. Therefore, we believe that for children with surgical indications, surgical treatment should be performed as soon as possible so as to achieve the largest recovery of APD and renal function. We acknowledge several limitations to our study. One is the follow-up time is enough long, another weakness of our study is the number of patient is not big. We will increase patient numbers and prolong follow-up time in our next study.

Conclusion

We conclude that short-term surgical outcomes of dismembered pyeloplasty for prenatally diagnosed Ureteropelvic junction Obstruction are satisfactory. In children with UPJO, early surgery may improve the subsequent APD and SRF of the involved renal unit. The maximum benefit for renal function and APD is obtained when relief of urinary tract obstruction is performed in younger children.

Conflict of interest

None declared

References

[1] Longpre M, Nguan A, Macneily AE, Afshar K. Prediction of the outcome of antenatally diagnosed hydronephrosis: a multivariable analysis. J Pediatr Urol. 2012 Apr: **8**:135-9

[2] Nguyen HT, Herndon CD, Cooper C, et al. The Society for Fetal Urology consensus statement on the evaluation and management of antenatal hydronephrosis. J Pediatr Urol. 2010 Jun: **6**:212-31

[3] Hashim H, Woodhouse CRJ. Ureteropelvic Junction Obstruction. European Urology Supplements. 2012: **11**:25-32

[4] Woolf AS. A molecular and genetic view of human renal and urinary tract malformations. Kidney Int. 2000 Aug: **58**:500-12

[5] Nguyen HT, Benson CB, Bromley B, et al. Multidisciplinary consensus on the classification of prenatal and postnatal urinary tract dilation (UTD classification system). J Pediatr Urol. 2014 Dec: **10**:982-98

[6] Madden-Fuentes RJ, McNamara ER, Nseyo U, Wiener JS, Routh JC, Ross SS.

Resolution rate of isolated low-grade hydronephrosis diagnosed within the first year of life. J Pediatr Urol. 2014 Aug: **10**:639-44
[7] Gonzalez R. Editorial: Ureteropelvic Junction Obstruction (UPJO) in Infants. Front Pediatr. 2017: **5**:148
[8] Dias CS, Silva JM, Pereira AK, et al. Diagnostic accuracy of renal pelvic dilatation for detecting surgically managed ureteropelvic junction obstruction. J Urol. 2013 Aug: **190**:661-6
[9] Arora S, Yadav P, Kumar M, et al. Predictors for the need of surgery in antenatally detected hydronephrosis due to UPJ obstruction--a prospective multivariate analysis. J Pediatr Urol. 2015 Oct: **11**:248 e1-5
[10] Anderson JC, Hynes W. Retrocaval ureter; a case diagnosed pre-operatively and treated successfully by a plastic operation. Br J Urol. 1949 Sep: **21**:209-14
[11] Salem YH, Majd M, Rushton HG, Belman AB. Outcome Analysis of Pediatric Pyeloplasty as a Function of Patient Age, Presentation and Differential Renal Function. The Journal of Urology. 1995 1995/11/01/: **154**:1889-93
[12] 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 Feb: **8**:25-8
[13] Kim SO, Yu HS, Hwang IS, Hwang EC, Kang TW, Kwon D. Early pyeloplasty for recovery of parenchymal thickness in children with unilateral ureteropelvic junction obstruction. Urol Int. 2014: **92**:473-6
[14] DiSandro MJ, Kogan BA. Neonatal management. Role for early intervention. The Urologic clinics of North America. 1998 May: **25**:187-97
[15] Babu R, Rathish VR, Sai V. Functional outcomes of early versus delayed pyeloplasty in prenatally diagnosed pelvi-ureteric junction obstruction. J Pediatr Urol. 2015 Apr: **11**:63 e1-5
[16] Chandrasekharam VV, Srinivas M, Bal CS, et al. Functional outcome after pyeloplasty for unilateral symptomatic hydronephrosis. Pediatr Surg Int. 2001 Sep: **17**:524-7
[17] Mayor G, Genton N, Torrado A, Guignard JP. Renal function in obstructive nephropathy: long-term effect of reconstructive surgery. Pediatrics. 1975 Nov: **56**:740-7
[18] Palmer LS, Maizels M, Cartwright PC, Fernbach SK, Conway JJ. Surgery versus observation for managing obstructive grade 3 to 4 unilateral hydronephrosis: a report from the Society for Fetal Urology. J Urol. 1998 Jan: **159**:222-8
[19] MacNeily AE, Maizels M, Kaplan WE, Firlit CF, Conway JJ. Does Early Pyeloplasty Really Avert Loss of Renal Function? A Retrospective Review. The Journal of Urology. 1993 1993/08/01/: **150**:769-73
[20] Rickard M, Braga LH, Oliveria JP, Romao R, Demaria J, Lorenzo AJ. 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. J Pediatr Urol. 2016 Aug: **12**:228 e1-6