

ORIGINAL ARTICLE

Evaluation of Outcome and the Influencing Factors on the Improvement of Renal Function after Anderson-Hynes Pyeloplasty in Children

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Abstract

Background: Pelvi-ureteric junction (PUJ) obstruction is one of the most common causes of Hydronephrosis in pediatric population. Anderson-Hynes (A-H) pyeloplasty is the standard surgical treatment of PUJ obstruction. The pyeloplasty is considered as successful when there is decrease in APD of renal pelvis in USG and improved SRF in DTPA renogram after pyeloplasty. There are many factors that may affect the SRF. These are the age of pyeloplasty, anteroposterior diameter (APD) of renal pelvis and baseline SRF.

Objective: The aim of our study was to observe the functional outcome after pyeloplasty in our setting and to find out the effect of the factors (age, APD, baseline SRF) on the postoperative SRF.

Methods: This quasi-experimental study was conducted at Pediatric urology department, Bangladesh Shishu Hospital and Institute, Dhaka among the children having A-H pyeloplasty for unilateral PUJ obstruction from September 2020 to December 2021. Patients associated with other anomalies, solitary kidney and redopyeloplasty cases were excluded. Changes in APD of renal pelvis and split renal function (SRF) of the obstructed kidneys were compared with the preoperative value to evaluate the outcome of pyeloplasty at 6 month after surgery. Patients were divided into Group 1: patient with improved renal function (postoperative SRF increased >5%), Group 2: patients with stable renal function (no change or <5% change in SRF), Group 3: patients with deteriorated renal function (decreased 5% or more in postoperative SRF). The groups were compared in terms of age, APD and base line SRF. The mean follows up time of the respondents was 12 months.

Results: Total 30 patients included in our study. The mean postoperative APD of renal pelvis was decreased 12.80 mm and postoperative renal SRF was increased 6.04% than preoperative SRF value. Both were statistically highly significant. 56.7% of patients had significant improvement of renal function and only 10% of them had deterioration of renal function. Remaining 33% patients had stable renal function. The relation between age category and APD of renal pelvis of the patients and postoperative renal function status was statistically not significant ($p > .05$). Patients who belongs to preoperative SRF <20% and >20% -40% category had statistically significant mean changes in their SRF after surgical intervention.

Conclusion: Our study reflected that APD and SRF can be used for predicting success after pediatric pyeloplasty for unilateral PUJ obstruction. The factor that may affect the outcome was low baseline SRF.

Keywords: PUJ, A-H Pyeloplasty, APD, SRF.

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Introduction

The pelvi-ureteric junction is the most common site of obstruction within the urinary tract in children.¹ The indication of surgery is to improve symptoms like pain and urinary tract infection, to improve renal drainage and preserve renal function. Anderson Hynes (A-H) pyeloplasty is the standard surgical treatment for PUJ obstruction. Ultrasonography (USG) and dynamic renal scan (DTPA) are commonly used for diagnosis and postoperative functional assessment. The pyeloplasty is considered as successful when the USG at postoperative period finds the improvement of the degree of hydronephrosis by the decreased anteroposterior diameter (APD) of renal pelvis,^{2,3} and in DTPA renal scan shows improvement in Split renal function (SRF).^{3,4} But all kidneys do not show improvement in split renal function (SRF) after pyeloplasty. There are many factors that may affect the postoperative SRF. These are the age of the patient, symptoms at presentation, anteroposterior diameter (APD) of renal pelvis, baseline/preoperative SRF.^{5,6} But there are lots of controversies. Some authors mention that pyeloplasty before 1 year of age showed greater improvement.⁵ But other studies reveal that the age of pyeloplasty is not a significant factor.⁶ Preoperative SRF in DTPA is reported to be important by some author.^{5,6} But this has been questioned in other studies.⁴ The aim of our study was to observe the changes of preoperative APD and SRF after pyeloplasty and the effect of the factors (age, APD, baseline SRF) on the postoperative SRF in our context.

Materials and Methods

This quasi-experimental study was conducted at Paediatric Urology Department, Bangladesh Shishu Hospital and Institute among the children, who underwent pyeloplasty for PUJ obstruction during September 2020 to December 2021. Patients with unilateral PUJ obstruction and normal contralateral kidney were included in this study. Patients of PUJ obstruction associated with other anomalies, solitary kidney and redopyeloplasty cases were excluded from the study. All patients were preoperatively evaluated by Ultrasonography and DTPA renogram. Significant Hydronephrosis in USG and obstruction in DTPA was usually the indication for surgery. In case of equivocal DTPA renogram, patients were operated if they were symptomatic or the hydronephrosis became progressive with an increase

in APD or decrease in cortical thickness (CT) in consecutive USG. Open Anderson- Hynes pyeloplasty with double J stent was performed in all patients. The stent was removed 6-8 weeks after operation. Postoperative follow up included USG and DTPA renogram at 6 months after surgery. Changes in APD of renal pelvis and split renal function (SRF) of the obstructed kidneys were compared with the preoperative value to evaluate the outcome of pyeloplasty. On the basis of changes of postoperative SRF from preoperative SRF, patients were divided into 3 groups. Group 1 included patients with improved renal function (postoperative SRF increased more than 5% from preoperative SRF). Group 2 included patients with stable renal function (no change or less than 5% change in SRF). Group 3 included the patients with deteriorated renal function (postoperative SRF decreased 5% or more than preoperative SRF). The groups were compared in terms of age, APD and base line SRF. The mean follows up time of the respondents was 12 months. Data were collected by semi structured questionnaire on variables of interests and analyzed by using Statistical Package for the Social Sciences (SPSS, version 25.0, Chicago, IL) software. Qualitative variables were described by frequency distribution, while quantitative variables were described by the mean and standard deviation. Chi-square test was applied for categorical data. Difference of means between or among the groups had tested by paired 't' test and Kruskal-Wallis H test respectively. The statistical significance was evaluated as appropriate probability level $p < 0.05$ or < 0.001 for all tests.

Results

From September 2020 to December 2021 total 30 patients were underwent Anderson-Hynes pyeloplasty for their unilateral PUJ obstruction in Pediatric Urology Department, Bangladesh Shishu Hospital and Institute. In this study, 77% patients had left sided hydronephrosis and remaining 23% patients had right sided hydronephrosis. Among all, 80% were male and only 20% were female. The mean (\pm SD) age of the respondents during the time of surgery was 25.80 (\pm 22.27) months and minimum and maximum age of the patients were 3 months & 7 years 5 months respectively. About 33.3% of the patients were belongs to below 1 year old , 60% were in between 1 year to 5 years and 6.7% were more than 5 years old (Table I).

Table I
Demographic variables and hydronephrosis affected side of the respondents (N=30)

| Demographic variables | | Frequency | Percent |
|------------------------------|------------|-----------|---------|
| Age (year) | <1 | 10 | 33.3 |
| | 1-5 | 18 | 60.0 |
| | >5 | 2 | 6.7 |
| | Total | 30 | 100.0 |
| Gender | Boy | 24 | 80.0 |
| | Girl | 6 | 20.0 |
| | Total | 30 | 100.0 |
| Hydronephrosis affected side | Right side | 7 | 23.0 |
| | Left side | 23 | 77.0 |
| | Total | 30 | 100.0 |

Outcome of the pyeloplasty was assumed by the comparison of mean changes of APD of renal pelvis and SRF after surgery (N=30). Paired samples t-test with p of <0.05 were used to compare the mean preoperative and postoperative APD of renal pelvis and SRF. Mean postoperative APD of renal pelvis was decreased 12.80 mm which was statistically highly significant (p<0.001). The comparison of mean changes of split renal function (SRF) after surgery among the respondents (N=30) revealed that on average, postoperative renal SRF was increased 6.04% (± 7.39 %) than preoperative SRF value among

the unilateral PUJ obstructed children which was also statistically highly significant (p <0.001) (Table II).

The patients were categorized into 3 groups according to postoperative renal functional status on the basis of postoperative SRF changes from baseline SRF level (n= 30) It revealed that more than half (56.7%) of them had significant improvement of renal function and only some (10%) of them had deterioration of renal function. Remaining 1/3rd (33%) patients had stable renal function (Table III).

Table II
Comparison of mean changes of outcome variables like anterior posterior diameter (APD) of renal pelvis and split renal function (SRF) before & after surgical intervention (N=30)

| Outcome variables | N | Mean | Std. Deviation | p |
|-------------------|-------------------------|------|----------------|-------|
| APD | Preoperative APD in mm | 30 | 44.03 | 14.88 |
| | Postoperative APD in mm | 30 | 31.23 | 8.32 |
| SRF | Preoperative SRF in % | 30 | 33.38 | 11.65 |
| | Postoperative SRF in % | 30 | 39.42 | 8.14 |

t (30) = 7.39, 95% CI (9.26, 16.34), p =.000 for comparison of pre & postoperative APD

t (30) = 4.48, 95% CI (3.28, 8.80), p =.000 for comparison of pre & postoperative SRF

Table III
Distribution of the patients according to postoperative renal function status on the basis of postoperative SRF changes from baseline SRF level (N=30)

| Postoperative renal function status according SRF changes from base line SRF level | Frequency | Percent |
|---|-----------|---------|
| Stable renal function (Changes of SRF within 5%) | 10 | 33.3 |
| Significant improvement of renal function (Postoperative SRF increase > 5% of preoperative level) | 17 | 56.7 |
| Deterioration of renal function (>5% decrease SRF from preoperative level) | 3 | 10.0 |
| Total | 30 | 100.0 |

Table IV explained the relation between age category of the patients and postoperative renal functional status. It revealed that about 66.7 % of the patients who were in between 1 year to 5 years and 50 % of the patients who were below 1 year had improvement in renal function after pyeloplasty. Again, 27.8% of the patients who were in between 1 year to 5 years old and 40 % of the patients who were below 1 year old had stable renal function after pyeloplasty. Among the patients who were above 5 years old, 50% of them had stable renal function and 50% had deterioration of renal function. Data were analyzed by Chi-square test and revealed that the relation between age category of the respondents and postoperative renal function status was statistically not significant ($p > .05$) (Table IV).

Table V showed the relation between preoperative anterior posterior diameter of renal pelvis and

different postoperative renal function status category among the respondents (N=30). Data were analyzed by Kruskal Wallis test and it revealed that there was no statistically significant difference in preoperative APD of renal pelvis among the different postoperative renal function status category.

Table VI showed comparison of mean changes of SRF after pyeloplasty from preoperative level among the three categories patient according to their baseline SRF function (n=30). It revealed that patients who belongs to preoperative SRF <20% and >20% -40% category had statistically significant ($p = <.05$ & $<.001$ respectively) mean changes in their SRF after surgical intervention. But among the patients (n=10) who belongs to more than 40% baseline SRF had no statistically significant ($p = >.05$) mean changes after pyeloplasty.

Table IV

Relation between age category of the patients and postoperative renal function status (N=30)

| Age | Postoperative renal function status | | | Total |
|-------------------|-------------------------------------|-----------|---------------|------------|
| | Stable | Improved | Deterioration | |
| Below 1 year | 4(40%) | 5(50.0%) | 1(10%) | 10(100.0%) |
| 1 year to 5 years | 5(27.8%) | 12(66.7%) | 1(5.6%) | 18(100.0%) |
| Above 5 years | 1(50.0%) | 0(0.0%) | 1(50.0%) | 2(100.0%) |
| Total | 10(33.3%) | 17(56.7%) | 3(10.0%) | 30(100.0%) |

$$\chi^2 = 5.55 \text{ df}=4, p=.235$$

Table V

Relation between preoperative anterior posterior diameter of renal pelvis and different postoperative renal function status category among the respondents (N=30)

| Ranks | | | |
|--|--|----|-----------|
| | Postoperative renal function status category | N | Mean Rank |
| Preoperative anterior posterior diameter of renal pelvis | Stable renal function | 10 | 17.60 |
| | Improved renal function | 17 | 15.76 |
| | Deterioration of renal function | 3 | 7.00 |
| | Total | 30 | |

$$\chi^2 = 3.453, p=0.178$$

Table VI

Comparison of mean changes of SRF from preoperative level after pyeloplasty among the three categories patient according to their baseline SRF function (N= 30)

| Category of the patients according to baseline SRF | SRF before & after Surgery | N | Mean | Std. Deviation | p* |
|--|----------------------------|----|-------|----------------|-------|
| Patients with Preoperative SRF $\leq 20\%$ | Preoperative SRF (%) | 4 | 12.98 | 3.58 | <.05 |
| | Postoperative SRF (%) | 4 | 27.13 | 3.33 | |
| Patients with Preoperative SRF >20%-40% | Preoperative SRF (%) | 16 | 30.61 | 5.60 | <.001 |
| | Postoperative SRF (%) | 16 | 38.13 | 4.83 | |
| Patients with Preoperative SRF > 40% | Preoperative SRF (%) | 10 | 45.96 | 2.54 | >.05 |
| | Postoperative SRF (%) | 10 | 46.40 | 6.83 | |

*paired 't' test

Discussion

PUJ obstruction is one of the common causes of hydronephrosis among the children.⁵ Anderson-Hynes Pyeloplasty is usually done to relieve obstruction and to improve the renal function. Traditionally, after pyeloplasty, repeat USG together with dynamic renal scans are the method of choice to confirm successful correction of obstruction. Successful pyeloplasty is assumed when there is decrease in APD in USG and/ or improvement of SRF in diuretic renography.³

This study demonstrated highly significant ($p < 0.001$) mean changes of preoperative and postoperative APD and SRF after 6 month of operation on postoperative follow up. In a prospective study conducted in the Department of Urology, outpatient clinic, Zagazig University Hospital in Egypt from September 2018 to September 2019 where a total of 30 children <18 years with unilateral UPJO were enrolled, among the patients, statistically significant changes occurred in between mean preoperative and postoperative APD and SRF after 6 months of pyeloplasty.³ Again, in another prospective, nonrandomized study where 68 patients were enrolled and underwent pyeloplasty between May 2010 to March 2012 in Egypt had similar findings of significant mean preoperative and postoperative APD changes. There was improvement in the mean DRF from preoperative to postoperative level but the difference had no statistical significance.⁷ Both of these study findings were similar to the present study findings.

According to postoperative SRF changes from baseline SRF value, in this study we grouped the patients into three categories. We found that 1/3rd patient had stable renal function and more than half had improved renal function after surgery but only 10% of patient had deterioration of their renal function. A study conducted among 52 consecutive patients at a tertiary care center in India between September 2009 to January 2011, where improvement in DRF were 30.8%, no change or stable renal function in 59.6% and deterioration of renal function in 9.6% patients.⁸

We analyzed the relation between the age category and preoperative anteroposterior diameter with postoperative renal function. The relation between age category of the patients and postoperative renal function status revealed, no statistical significance. Similar finding was mentioned by McAleer et al⁴.

They mentioned that renal functional differences did not depend on patient's age at the time of surgery. In contrast, another study found improvement in DRF in almost all patients who had antenatal diagnosis of PUJ obstruction and surgically treated during their first year of life.⁹ But they did not mention how many cases were improved by >5% in DRF. Although due to the widespread use of routine antenatal USG, the prenatal detection of hydronephrosis is common in developed country. But in our country prenatal detection is not very common. In this study, among the 30 patients, no one was prenatally diagnosed.

In our study, the relation of preoperative APD with postoperative SRF found not significant. But Koff et al¹⁰ reported that the beneficial effects of hydronephrosis in 2003. Though the increased APD of renal pelvis is a sign of obstruction but he showed that hydronephrosis may be a compensatory mechanism to protect the kidney from high pressure and renal damage. Another author also mentioned that large APD is one of three independent factors which predict the improvement in renal function of >5% in their 85 cases.¹¹ Chipde et al⁸ prospectively studied among 52 patients and also found that APD and pelvis cortical ratio were the most important predictors of improvement after pyeloplasty. In our study, the small sample size might be the cause of non-significance.

In this study we compared the mean changes of SRF after surgery among the patients according to different level of preoperative SRF function. We found that patients who belongs to preoperative SRF $\leq 20\%$ ($p = < 0.05$) and $>20\% - 40\%$ ($p = < 0.001$) category had statistically significant improvement in their SRF after surgical intervention. But among the patients, who belongs to $>40\%$ baseline or preoperative SRF, had no statistically significant ($p = > 0.05$) changes in postoperative SRF. These findings were consistent with other study.⁵ They found that kidneys with low baseline SRF (below 30%) demonstrated improved renal function after pyeloplasty. On the other hand, the kidneys with initial SRF close to 40% did not improve after pyeloplasty. It happened because the kidneys with low preoperative SRF had more room to improve and so demonstrated more improvement when obstruction was relieved by pyeloplasty. The low baseline DRF was shown to be a predictor of improvement in other studies.^{6,11,12} But in contrast McAleer et al⁴ described that the renal function did

not improve after pyeloplasty regardless of initial level of renal function.

Follow up period in our study was short. But there is no well accepted duration and follow up protocol for the patients with PUJ obstruction after surgical intervention. In this study though most of the patients were followed up to 1 year or more but some patients did not come after 6 month of operation for follow up. Ikari et al¹³ studied about the length of follow-up in patients underwent pyeloplasty. They concluded that, satisfactory diuretic renogram at 3 or 6 months after pyeloplasty with maintained renal function and stable hydronephrosis suggests no need of further follow up. But long duration follow up can find out the changes of renal functional status after 1-2 years of pyeloplasty.

The limitations of our study were small sample size and the accuracy of results of SRF in DTPA renogram were not consistent as all of them were not done in same center.

Conclusion

USG parameter such as APD and SRF in DTPA renogram can be used for predicting success after pediatric pyeloplasty for unilateral PUJ obstruction. In the study it has been found that the recoverability of renal function in affected renal unit after pyeloplasty can be predicted in patients with the preoperative low DRF.

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