

**Brief Article**

## Post-operative sonological evaluation of pelvi-ureteric drainage of unilateral A-H pyeloplasty in children

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### ABSTRACT

**Background:** Pelvi-ureteric junction obstruction is the most common cause of pediatric hydronephrosis where A-H pyeloplasty with D-J stent is the established treatment option with a high success rate. We observed the predictive value of sonological parameters for early detection of postoperative obstruction at the new pelvi-ureteric junction in children following unilateral A-H pyeloplasty.

**Methods:** This cross-sectional study included 12 children who underwent unilateral A-H pyeloplasty. Post-operative follow-up was done after D-J stent removal and completed within six months. Maximum antero-posterior pelvic diameter (APPD), cortical thickness (CT), and pelvi-cortical (P/C) ratio were compared.

**Results:** Mean APPD was 32.7 mm at the day after removal of the stent, 24.4 mm at one month, and 19.7 mm at four months. Mean CT was 5.2 mm at the day after removal of the stent, 6.1 mm at one month and 8.0 mm at four months. P/C ratio was 8.3 mm at the day after removal of the stent, 5.2 mm at one month, and 3.4 mm at four months. Increased CT and reduced P/C ratio were significant at four months ( $P=0.05$ ).

**Conclusion:** CT value and P/C ratio can be used as an early marker of success for pelvi-ureteric drainage following A-H pyeloplasty.

**Keywords:** hydronephrosis, pyeloplasty, ultrasonography, cortical thickness, renal pelvis, pelvi-cortical ratio

### INTRODUCTION

Pelvi-ureteric junction obstruction (PUJO) is the most common cause of pediatric hydronephrosis encountered by pediatric surgeons where A-H pyeloplasty with D-J stent is the established treatment option for hydronephrosis with a high success rate.<sup>1,3</sup> The decision for surgical intervention is usually based on the decrease in differential renal function (DRF) on diuretic renogram and worsening of hydronephrosis on ultrasonography findings.<sup>1,2</sup> Even after pyeloplasty, persistence and sometimes worsening of hydronephrosis have also been reported.<sup>3</sup> For the

effectiveness of the procedure, evaluation of trans-anastomotic drainage after removal of the stent is important. The quality of renal parenchyma (thickness and appearance) is a vital parameter that parallels with renal function. Post-operative proper renal parenchymal growth indicates obstruction free drainage.<sup>1,2</sup> Sonological follow-up of hydronephrosis associated with PUJO in children can be used for different measures like pelvic diameter, condition and thickness of parenchyma, calyceal dilatation or pelvi-calyceal/ pelvi-cortical ratio.<sup>4</sup>

**HIGHLIGHTS**

1. Early post-operative follow-up can avoid the recurrences of hydronephrosis after A-H Pyeloplasty treatment.
2. Ultrasonography is the easiest, cheapest, most widely available, and most effective way to detect recurrences in post-operative follow-up.

In this study, we documented prospective ultrasonographic changes in antero-posterior pelvic diameter (APPD), cortical thickness (CT) and pelvis/cortex ratio (P/C ratio) following A-H pyeloplasty. To determine the usefulness, each of these indices in assessing postoperative drainage were observed through new PUJ at three different time points and detection of early recurrence for prevention of further damage of renal function.

**METHODS***Study participants*

This study was conducted from January to December 2021. Twelve children (6 months to 5 years) with unilateral PUJ obstruction who underwent A-H pyeloplasty were studied. A standard open A-H pyeloplasty with D-J stent in situ was carried out at Department of Pediatric Surgery of Bangabandhu Sheikh Mujib Medical University (BSMMU). The indications for pyeloplasty included a combination of symptoms, and worsening of hydronephrosis or function.<sup>3</sup> Patients having urinary tract pathology (vesico-ureteric reflux, vesico-ureteric junction obstruction, etc.) were excluded. Patients were followed up at one and four months post-operatively.

*Ultrasonography*

Ultrasonography was performed by the same sonologist post-operatively. A total of three visits were carried out, first one at the sixth week of post-operative period (immediate at the day after D-J stent removal). The second and third visit was done after one and four months respectively after the first visit. A standard protocol was followed at every visit to measure sonographic parameters. Maximum antero-posterior renal pelvic diameter (APPD) in coronal section and

maximum polar cortical thickness (CT) in longitudinal section were measured. We preferred to measure maximum CT values because recovery improvements can vary in different regions and taking an average would bias the results. P/C ratio was calculated by dividing maximum APPD by maximum CT.

*Statistical analysis*

Data on APPD, CT and P/C ratio were presented as mean (standard deviation). The indices after removal of D-J stent following A-H pyeloplasty were compared using paired student's t-test.  $P < 0.05$  was defined as statistically significant.

**RESULTS**

Twelve patients underwent A-H pyeloplasty with D-J stent for unilateral PUJ obstruction. The mean APPD was 32.7 mm at the day after D-J stent removal, 24.4 mm and 19.7 mm at first month and fourth month after

**TABLE 1** Changes in sonographic parameters after one month of surgery in patients with PUJ obstruction (n=12)

Variables	Immediate after*	1-month post-operative <sup>c</sup>	$P_t$
	Mean (SD) <sup>b</sup>	Mean (SD) <sup>b</sup>	
Antero-posterior pelvic diameter (mm)	32.7 (20.8)	24.4 (16.2)	0.28
Cortical thickness (mm)	5.2 (2.3)	6.1 (2.4)	0.37
Pelvis/cortex ratio	8.3 (7.8)	5.2 (5.2)	0.25

\*D-J stent removal  
<sup>b</sup>Standard deviation  
<sup>c</sup>Independent sample t-test

stent removal, respectively. The size of pelvic diameter reduced at the first month but was more remarkable at the fourth month, though not statistically significant. The mean CT was 5.2 mm at the day after D-J stent removal, 6.1 mm at the first month and 8.0 mm at the fourth month after stent removal. We observed that CT value increased significantly after four months ( $P=0.03$ ) but not in the first month ( $P=0.37$ ). The P/C ratio was 8.3 mm at the day after D-J stent removal, 5.2 mm at the first month and 3.4 mm at the fourth month after stent removal. The reduction in P/C ratio was significant at the fourth month ( $P=0.05$ ), indicating that P/C ratio could be useful as an early sonographic marker of resolution of hydronephrosis following pyeloplasty by free drainage through new PUJO (TABLE 1 and 2).

**TABLE 2** Changes in sonographic parameters after four months of surgery in patients with PUJ obstruction (n=12)

Variables	Immediate after*	4-month post-operative*	P <sup>†</sup>
	Mean (SD) <sup>‡</sup>	Mean (SD) <sup>‡</sup>	
Antero-posterior pelvic diameter (mm)	32.7 (20.8)	19.7 (12.6)	0.08
Cortical thickness (mm)	5.2 (2.3)	8.0 (3.6)	0.03
Pelvis/cortex ratio	8.3 (7.8)	3.4 (3.1)	0.05

\*DJ stent removal  
<sup>†</sup>Standard deviation  
<sup>‡</sup>Independent sample t-test

## DISCUSSION

Anderson-Hynes dismembered pyeloplasty is the standard procedure performed together with resection of the dilated renal pelvis.<sup>4</sup> Traditionally after pyeloplasty, repeated ultrasonography together with radionuclide scans are the method of choice to confirm correction of obstruction and successful establishment of renal drainage.<sup>5</sup> Intravenous access and urethral catheterization are required in nuclear scanning and radiation exposure with additional costs.<sup>6</sup> However, ultrasonography is cheap, easy to perform and has limited radiation exposure. As follow up with ultrasonography ensure accuracy with safety, it is easily chosen by paediatric surgeons.

Severity of hydronephrosis can be determined by pelvicalyceal/ cortex area ratio (P/C ratio) which is found to be comparable to conventional renography.<sup>7</sup> Added to that, renal cortical thickness area provide a more accurate estimate of renal size and function in hydronephrotic kidney.<sup>3</sup> The renal pelvic size improvement is not uniform and thickness of the cortex correlates well with renal function. So, we measured P/C ratio where in addition to pelvic size, cortical thickness is measured to assess resolution of hydronephrosis or establishment of drainage through new PUJO.<sup>8,9</sup>

All patients in our study underwent successful A-H pyeloplasty. After removal of D-J stent, we started follow-up. After removal of the stent, improvement was remarkable after the first month but significant after four months. All renal parameter and APPD was reduced with improvement in CT value, ultimately reducing P/C ratio. In this basis we conclude that proper drainage has been maintained. A study from

Toronto, Canada showed improvement in APPD pre- and postoperatively where post-operative APPD was less associated with success of pyeloplasty.<sup>2</sup> Another study done in Montreal Children's Hospital of Canada showed reduction of APPD reflecting the success of an operation.<sup>7</sup> However, early improvement on ultrasound could also be due to renal pelvic reduction rather than real improvement.

There are studies to show that cortical thickness correlates well with renal function whereas pelvis size improvement is not uniform. That is why, renal growth or increase in cortical thickness is also used as an indicator parameter for assessing post-operative improvement and obstruction free drainage.<sup>9,13</sup> Another study shows the P/C ratio at preoperatively, after three months, and one year after operation. The reduction in P/C ratio was significant after three months ( $P<0.01$ ) as well as at one year ( $P<0.01$ ).<sup>3</sup>

We conclude that sonological parameter for the successful establishment of urinary drainage through new PUJ just after the removal of DJ stent. One limitation of our study is the small patient population and short duration. However, this is because it is a longitude study from a single centre.

## Conclusion

APPD, cortical thickness and P/C ratio can be useful as non-invasive and simple criterion to assess the post-operative pelvi-ureteric drainage that indicate early outcome of pyeloplasty.

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## Author Contributions

- Conception and design: MSI, MRA
- Acquisition, analysis, and interpretation of data: MSI, MRA
- Manuscript drafting and revising it critically: MSI
- Approval of the final version of manuscript: MSI, MRA, AKMZH, MTHS, KMDI, SKM, MN, MABA
- Guarantor accuracy and integrity of the work: MSI, MRA

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### Conflict of Interest

The authors have no conflict of interest to declare.

### Ethical approval

The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). This study was approved by the institutional review board of BSMMU (2021/1317). Written informed consent was obtained from the parents of all the patients for research and publication of this study.

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