

To evaluate the minimum number of renal scans required to follow pediatric patient postpyeloplasty

ABSTRACT

The aim of the study is to evaluate the minimum number of renal scans required to follow pediatric patients postpyeloplasty. We prospectively reviewed the renal scans of 145 children with unilateral pelvi-ureteric junction obstruction who underwent dismembered pyeloplasty. Patients were then divided into four groups based on preoperative split renal function. All patients were followed with renal scan and ultrasound for minimum of 4 years. Renal scan and ultrasound were done after stent removal at 3, 6, and 12 months and then yearly after surgery. Drainage pattern (T1/2) was seen in all groups, except in patients where there was no comment on drainage pattern. Statistical analysis was performed using the Friedman ANOVA and Wilcoxon signed-ranks test as a *post hoc* test with Bonferroni correction and Kruskal–Wallis test with Mann–Whitney U-test as a *post hoc* test with Bonferroni correction. On comparison of the pattern of drainage with time in Groups 1–4, it was found that there was no significant difference with time in Group 1. Then, further, using Wilcoxon signed-rank test as *post hoc* test for Friedman ANOVA, Group 2 showed statistically significant difference in drainage pattern in scans between 6 months and 1 year, Group 3 showed statistically significant difference in drainage pattern in scans between 3 months and 1 year, and Group 4 showed statistically significant difference in drainage pattern in scans done between 3 and 6 months ($P < 0.05$). Minimum of three renal scans were required for paediatric patients post pyeloplasty at 3 months, 6 months and 1 year in the follow up period.

Keywords: Drainage, pelvi-ureteric junction obstruction, pyeloplasty, renal scan

INTRODUCTION

Pelvi-ureteric junction obstruction (PUJO) is defined as an obstruction of the urine flow from the renal pelvis to the proximal ureter. The resultant back pressure within the renal pelvis due to obstruction may lead to progressive renal damage. PUJO has been classically treated through the standard open approach with outstanding results. Since Anderson-Hynes (AH) reported the first dismembered pyeloplasty, a great number of authors have published excellent results, with overall success rates of 90%–100%.^[1–4]

The goal of the surgery is to improve renal drainage and to maintain or improve renal function. After pyeloplasty, we generally follow these patients with renal scan at different intervals of time, symptoms, and ultrasound kidney-ureter-bladder (KUB) region. Diethylenetriamine pentaacetic acid (DTPA) renal scan is a procedure which involves minimal but some radiation exposure.^[5,6] Hence,


how long to follow these patients with renal scan and minimum number of scans required for follow-up? We try to answer these questions through this prospective observational study.

**SHASHWAT VERMA, PAYAL SAXENA¹,
SANJEET KUMAR SINGH², SUKHANSHI KHANDPUR³,
SATYAWATI DESWAL, NARVESH KUMAR⁴,
ANJANA SINGH⁵**

Departments of Nuclear Medicine and ²Urology, Dr. RMLIMS, ¹Department of Obstetrics and Gynaecology, Chandan Hospital, ³Department of Statistics, Lucknow University, ⁴Department of Nuclear Medicine, Apollo Medics, Lucknow, ⁵Department of Pathology, Mayo Institute of Medical Sciences, Barabanki, Uttar Pradesh, India

Address for correspondence: Dr. Sanjeet Kumar Singh, Department of Urology, Dr. RMLIMS, Lucknow, Uttar Pradesh, India.
E-mail: sanjeetsingh1982@yahoo.in

Submission: 09-Jan-19, **Accepted:** 05-Apr-19, **Published:** 17-Jan-20

Access this article online	
Website: www.wjnm.org	Quick Response Code 
DOI: 10.4103/wjnm.WJNM_3_19	

This is an open access journal, and articles are distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 4.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.

For reprints contact: reprints@medknow.com

How to cite this article: Verma S, Saxena P, Singh SK, Khandpur S, Deswal S, Kumar N, *et al.* To evaluate the minimum number of renal scans required to follow pediatric patient postpyeloplasty. World J Nucl Med 2020;19:106-10.

MATERIALS AND METHODS

We prospectively reviewed the renal scans of 145 children, who underwent AH dismembered pyeloplasty for unilateral PUJO. Ethical approval for the study was granted by the institutional ethics committee (letter number 8597/RMLIMS/2018 dated 15.03.2018). Of 145 children, 94 were boys and 51 were girls. The patient's age ranged from 6 months to 12 years. Patients with bilateral disease, associated vesicoureteral reflux, and solitary functioning kidney with PUJO were excluded from this study. All patients were evaluated preoperatively with ultrasonography (USG) KUB region and ^{99m}Tc -DTPA diuretic renography to confirm significant PUJO as per the well-tempered protocol.^[5] Ultrasound KUB showing progressive hydronephrosis and renal scan showing deteriorating renal function or significant obstruction were considered as surgical indications for pyeloplasty. All patients underwent standard AH pyeloplasty with internal ureteral stent placement. Double-J stent was removed after 6 weeks. Follow-up period was 4 years for all the patients. In follow-up, we looked for any symptoms (flank pain, recurrent fever, and dysuria) and physical examination along with ultrasound and renal diuretic scan at different time intervals. USG and renal scan were undertaken during the initial examination and were repeated after surgery at 3 months, 6 months, 1 year, and then yearly. The degree of hydronephrosis was graded according to the Society of Fetal Urology grading system.^[7]

After adequate hydration and patient preparation, radionuclide imaging was performed in supine position with the gamma camera. Posterior dynamic imaging of the kidneys was obtained. Data were acquired at 15-s intervals with a 128×128 matrix size. Up to 40 mg (1 mg/kg) of furosemide was injected intravenously with injection of 185 MBq (5 mCi) of ^{99m}Tc -DTPA (F0 protocol). Patients were asked to void before the starting of the study. Clearance half-time of the radioactivity from each side of the renal pelvis was calculated with background subtraction by exponential curve fitting after the furosemide injection. A change in split renal function (SRF) of within 5% of the preoperative level was defined as stable renal function. A more than 5% increase or decrease in SRF as compared to preoperative level was defined as improved and decreased renal function, respectively.

Patients were then divided into four groups: Group 1 with SRF between 10% and 20%, Group 2 between 20% and 30%, Group 3 between 30% and 40%, and Group 4 of $\geq 40\%$.

The number of children in Groups 1, 2, 3, and 4 was 34, 50, 20, and 41, respectively. Patients were followed with renal

scan and ultrasound for minimum of 4 years. Drainage pattern was evaluated in all groups.

Data were analyzed using software SPSS 20 (IBM SPSS Statistics for Windows, Version 20.0. Armonk, NY: IBM Corp., USA) ($P < 0.05$ is considered statistically significant).

Statistical analysis was performed using the Friedman ANOVA and Wilcoxon signed-ranks test as a *post hoc* test with Bonferroni correction applied ($P < 0.003$ is considered statistically significant) and Kruskal–Wallis test with Mann–Whitney U-test as a *post hoc* test with Bonferroni correction applied ($P < 0.008$ is considered statistically significant). Written consent was taken from all the patients. Institutional ethics and review board approval were obtained.

RESULTS

The mean age was 4.48 ± 0.197 years at the time of operation with boy-to-girl ratio of 1.84. Of 145 patients, 64 were symptomatic, while remaining 81 patients were incidentally diagnosed [Tables 1 and 2].

Using the Friedman ANOVA test, when we compared the pattern of drainage with time in Groups 1–4, it was found that there was no significant difference with time in Group 1 ($P = 0.691$), while rest of the groups showed statistically significant difference with time ($P = 0.000$) [Table 3 and Graph 1].

Then, further, using Wilcoxon signed-rank test as *post hoc* test for Friedman ANOVA, Group 2 showed statistically significant difference in drainage pattern in scans between 6 months and 1 year ($P = 0.002$) but no difference in scans between

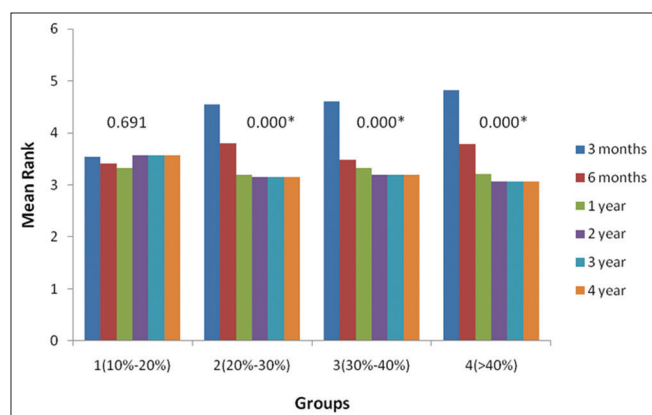
Table 1: Type of presentation

Symptom	Number of patients
Flank pain	37
Lump	5
Fever + flank pain	16
Stone	6
Incidental	81

Table 2: Patient's characteristics

Demographic characteristics	Number
Boy:girl	94:51
Type of surgery (Laparoscopy vs. open)	119:26
Crossing of the vessel (%)	29
Side (right:left)	63:82
Hydronephrosis Grade-3 and 4 (preoperative)	99:46
Hydronephrosis Grade-2, 3, and 4 (postoperative)	40:74:31

1 year and 2 years. Group 3 showed statistically significant difference in drainage pattern in scans between 3 months



Graph 1: Pattern of drainage with time (Friedman ANOVA)

and 1 year ($P = 0.003$) but did not show much statistically significant difference in drainage pattern in scans between 3 and 6 months ($P = 0.005$). Group 4 showed statistically significant difference in drainage pattern in scans done between 3 and 6 months ($P = 0.000$) but not significant difference in drainage pattern in scans done between 6 months and 1 year [Table 4]. Since a 1 year follow up was found to be adequate in group 2 and group 3, it is better to have a longer follow up of at least 6 months to have clinically better results in group 4 also.

Further analysis using Kruskal–Wallis test showed statistically significant difference ($P = 0.000$) in drainage pattern among various groups at all-time intervals that is from 3 months to 4 years [Table 5 and Graph 2].

Table 3: Pattern of drainage with time

Groups (%)	Median (mean rank)						P
	3 months	6 months	1 year	2 years	3 years	4 years	
1 (10-20)	2.5 (3.54)	2.5 (3.41)	2.0 (3.32)	3.0 (3.57)	3.0 (3.57)	3.0 (3.57)	0.691
2 (20-30)	2.0 (4.55)	2.0 (3.80)	1.0 (3.20)	1.0 (3.15)	1.0 (3.15)	1.0 (3.15)	0.000*
3 (30-40)	2.0 (4.60)	1.0 (3.48)	1.0 (3.33)	1.0 (3.20)	1.0 (3.20)	1.0 (3.20)	0.000*
4 (>40)	2.0 (4.82)	1.0 (3.79)	1.0 (3.21)	1.0 (3.06)	1.0 (3.06)	1.0 (3.06)	0.000*

*P < 0.05 Significant. Friedman ANOVA

Table 4: Pattern of drainage with time

Time intervals	Z (P)		
	2	3	4
3 months and 6 months	-3.500 (0.000*)	-2.828 (0.005)	-3.742 (0.000*)
3 months and 1 year	-4.707 (0.000*)	-3.000 (0.003)*	-4.690 (0.000*)
3 months and 2 years	-4.630 (0.000*)	-2.887 (0.004)	-4.899 (0.000*)
3 months and 3 years	-4.630 (0.000*)	-2.887 (0.004)	-4.899 (0.000*)
3 months and 4 years	-4.630* (0.000*)	-2.887 (0.004)	-4.899 (0.000*)
6 months and 1 year	-3.162 (0.002*)	-1.000 (0.317)	-2.530 (0.011)
6 months and 2 years	-3.317 (0.001*)	-1.414 (0.157)	-2.887 (0.004)
6 months and 3 years	-3.317 (0.001*)	-1.414 (0.157)	-2.887 (0.004)
6 months and 4 years	-3.317 (0.001*)	-1.414 (0.157)	-2.887 (0.004)
1 year and 2 years	-1.000 (0.317)	-1.000 (0.317)	-1.414 (0.157)
1 year and 3 years	-1.000 (0.317)	-1.000 (0.317)	-1.414 (0.157)
1 year and 4 years	-1.000 (0.317)	-1.000 (0.317)	-1.414 (0.157)
2 years and 3 years	0.000 (1.000)	0.000 (1.000)	0.000 (1.000)
2 years and 4 years	0.000 (1.000)	0.000 (1.000)	0.000 (1.000)
3 years and 4 years	0.000 (1.000)	0.000 (1.000)	0.000 (1.000)

*P < 0.03 Significant. Wilcoxon signed-ranks test as post hoc test. *P < 0.003 is considered statistically significant after Bonferroni correction

Table 5: Pattern of drainage between groups

Groups	Median					
	3 months	6 months	1 year	2 years	3 years	4 years
1 (10%-20%) (n=34)	2.5	2.5	2.0	3.0	3.0	3.0
2 (20%-30%) (n=50)	2.0	2.0	1.0	1.0	1.0	1.0
3 (30%-40%) (n=20)	2.0	1.0	1.0	1.0	1.0	1.0
4 (>40%) (n=41)	2.0	1.0	1.0	1.0	1.0	1.0
P	0.000*	0.000*	0.000*	0.000*	0.000*	0.000*

*P < 0.001. Kruskal- Wallis H test

On applying Mann–Whitney U-test as *post hoc* for Kruskal–Wallis test, it was observed that the statistically significant difference in drainage at various time intervals was seen between Group 1 and rest of the groups ($P = 0.000$) but not between Groups 2 and 3, Groups 2 and 4, and Groups 3 and 4 [Table 6].

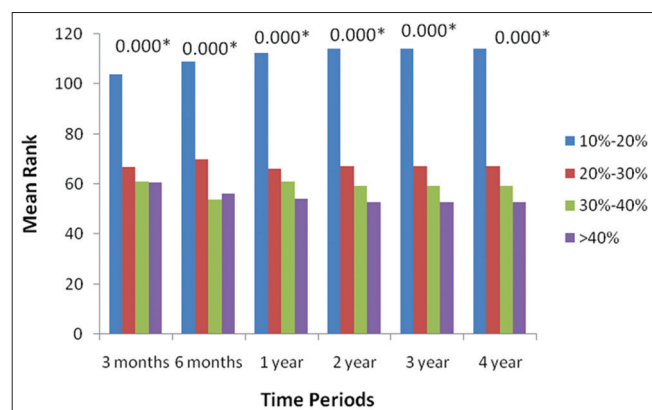
Two patients in Group 1 underwent simple nephrectomy as preoperative SRF was 12% and in postoperative SRF was 7% and also symptomatic.

DISCUSSION

PUJO is a congenital condition. Diagnosis of PUJO is usually done by radionuclide renal scans and ultrasound. The decision to proceed for surgery is based on significant obstruction on renal scan as per well-tempered renogram.^[8] However, it also depends on other variables such as symptoms and the degree of dilatation of the pelvicalyceal system in case of equivocal obstruction.

Psooy *et al.* showed that after an unobstructed diuretic renogram, recurrence of the obstruction was unlikely and did not justify a long-term follow-up.^[9]

The question remains as to whether children after a successful pyeloplasty need a longer follow-up? Whether kidneys with good function after pyeloplasty remain so and poorly functioning kidneys show further deterioration with time?^[10]



Graph 2: Pattern of drainage between groups (Kruskal–Wallis test)

Table 6: Pattern of drainage between groups

Time periods	Z (P)					
	1 and 2	1 and 3	1 and 4	2 and 3	2 and 4	3 and 4
3 months	-4.374 (0.000*)	-3.973 (0.000*)	-5.150 (0.000*)	-0.592 (0.554)	-0.817 (0.414)	-0.039 (0.969)
6 months	-4.921 (0.000*)	-4.735 (0.000*)	-5.675 (0.000*)	-1.701 (0.089)	-1.799 (0.072)	-0.302 (0.763)
1 year	-5.418 (0.000*)	-4.658 (0.000*)	-6.274 (0.000*)	-0.611 (0.541)	-1.834 (0.067)	-0.907 (0.364)
2 years	-5.621 (0.000*)	-4.893 (0.000*)	-6.582 (0.000*)	-0.953 (0.341)	-2.343 (0.019)	-0.980 (0.327)
3 years	-5.621 (0.000*)	-4.893 (0.000*)	-6.582 (0.000*)	-0.953 (0.341)	-2.343 (0.019)	-0.980 (0.327)
4 years	-5.621 (0.000*)	-4.893 (0.000*)	-6.582 (0.000*)	-0.953 (0.341)	-2.343 (0.019)	-0.980 (0.327)

* $P < 0.001$. Mann-Whitney U-test as *post hoc* test for Kruskal–Wallis H test. $P < 0.008$ is considered statistically significant for Mann-Whitney U test after Bonferroni correction

A low SRF might be due to either deterioration of the operated kidney or contralateral compensation, and determining absolute kidney function might be helpful to establish the natural course of previously obstructed kidneys. However, there are few data on absolute renal function before and after the surgery as renal blood flow and the glomerular filtration rate are difficult to establish with scintigraphy alone.

Chandrasekharam *et al.* reported that in 68 children with symptomatic PUJO, renal scans were taken 3 months and 1, 2, and 5 years after surgery, and it was concluded that in patients with impaired preoperative function, the improvement in SRF continued until 1 year after surgery. There was no further improvement after that period and the SRF remained stable.^[11]

In patients, where drainage could not be commented, the SRF should be taken into account. If there is stable or improved SRF, then these patients should be followed for 1 year.^[10]

In our study, we found that significant difference in drainage pattern is seen till 1 year in Group 2, 3 months in Group 3, and 6 months in Group 4. In Group 3, the difference in drainage pattern between time interval 3 and 6 months was not much statistically significant as per Wilcoxon signed-rank test, but statistically significant drainage pattern difference was seen between 3 months and 1 year scans. Hence, as a safe standard, we can follow-up patients till 1 year.

Furthermore, in patients, where drainage cannot be commented, the SRF should be considered and seen for any change/improvement.

DTPA renal scan although involves very less radiation exposure, still the question of having radiation exposure persists and that too in children. The radiation exposure caused by renal scintigraphy is in most cases regarded as negligible, which is about one-third of the average annual exposure of naturally existing radiation sources in adult. Moreover, in many instances, renal scintigraphy is actively implemented as critical method for diagnosing and evaluating

various urologic problems in pediatric patients without concerns about toxic or pharmacologic side effects and allergic reactions.^[10,11] Hence, with the help of this study, we could ascertain that three renal scans are sufficient enough for the follow-up such patients and no need for long-term follow-up till 4 years preventing from unnecessary radiation burden.

CONCLUSION

We concluded that a minimum of three renal scans are required for postpyeloplasty pediatric patients, i.e., at 3 months, 6 months, and 1 year.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

REFERENCES

1. Munver R, Sosa RE, del Pizzo JJ. Laparoscopic pyeloplasty: History, evolution, and future. *J Endourol* 2004;18:748-55.
2. Brooks JD, Kavoussi LR, Preminger GM, Schuessler WW, Moore RG. Comparison of open and endourologic approaches to the obstructed ureteropelvic junction. *Urology* 1995;46:791-5.
3. Murphy JT. The kidney. In: Murphy JT, Desnos E, editors. *History of Urology*. Springfield, Illinois: Charles C. Thomas; 1972. p. 201.
4. Persky L, Krause JR, Boltuch RL. Initial complications and late results in dismembered pyeloplasty. *J Urol* 1977;118:162-5.
5. Jang SJ. Nuclear medicine in pediatric urology. *Child Kidney Dis* 2015;19:14-22.
6. Soares Machado J, Tran-Gia J, Schlögl S, Buck AK, Lassmann M. Biokinetics, dosimetry, and radiation risk in infants after 99mTc-MAG3 scans. *EJNMMI Res* 2018;8:10.
7. Fernbach SK, Maizels M, Conway JJ. Ultrasound grading of hydronephrosis: Introduction to the system used by the society for fetal urology. *Pediatr Radiol* 1993;23:478-80.
8. Conway JJ, Maizels M. The "well tempered" diuretic renogram: A standard method to examine the asymptomatic neonate with hydronephrosis or hydroureteronephrosis. A report from combined meetings of the society for fetal urology and members of the pediatric nuclear medicine council – The society of nuclear medicine. *J Nucl Med* 1992;33:2047-51.
9. Psooy K, Pike JG, Leonard MP. Long-term followup of pediatric dismembered pyeloplasty: How long is long enough? *J Urol* 2003;169:1809-12.
10. van den Hoek J, de Jong A, Scheepe J, van der Toorn F, Wolffenbuttel K. Prolonged follow-up after paediatric pyeloplasty: Are repeat scans necessary? *BJU Int* 2007;100:1150-2.
11. Chandrasekharam VV, Srinivas M, Bal CS, Gupta AK, Agarwala S, Mitra DK, *et al.* Functional outcome after pyeloplasty for unilateral symptomatic hydronephrosis. *Pediatr Surg Int* 2001;17:524-7.