

# OUTCOME OF PEDIATRIC RENAL BIOPSY WITH MONOPTY GUN TECHNIQUE

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## ABSTRACT

**Objective** To determine the outcome of percutaneous renal biopsy (PRB) using Monopty-gun technique (MGT) and to compare the results of sedation with general anesthesia (GA) used for the procedure.

**Study design** Descriptive study.

**Place & Duration of study** Department of Pediatrics at National Institute of Child Health (NICH) and the Kidney Center Postgraduate Training Institute (KPTI), Karachi from June 2005 to February 2010.

**Methodology** Renal biopsies were performed either under sedation / GA at NICH and KPTI respectively using MGT under ultrasound guidance (USG) after routine tests. A resident / nurse monitored the procedure. Data including age, sex, indication, vitals monitored, number of attempts per patient, glomeruli per biopsy and complications were recorded. Using Statistical-Package-Scientific-Software (SPSS) version-15, descriptive statistics were applied. Paired test was used to compare pre-and-post procedure vitals.  $P < 0.05$  was considered significant.

**Results** A total of 147 biopsies in 145 children were performed. Boys were 79(54.48%) and girls 66(45.51%). Mean age was  $7.31 \pm 4.23$  years. Most of the procedures were performed under sedation ( $n = 105$ , 71.42%). Indications were nephrotic syndrome (NS) in 96(65.3%), secondary glomerulonephritis (SGN) in 17(11.6%), nephritic-nephrotic syndrome (NNS) in 16 (10.9%), congenital nephrotic syndrome (NS) in 15(10.2%) and others 3(2.06%). The success and adequacy rate was 95.91% and 95.23% respectively. Failure occurred in 5(3.4%) cases. Overall, 26(17.68%) complications were observed in 21(14.28%) patients with 6(4%) being major. Technique related complications (20, 76.92%) were more than sedation/GA related (SGRC -  $n = 6$ , 23%). The complications were more in sedation but the outcome was better in GA.

**Conclusions** MGT is a safe for PRB in children. The success, adequacy and complication rates in our study are in uniformity with the current standards.

**Key words** Renal biopsy, Monopty-gun technique, Complications.

## INTRODUCTION:

Percutaneous renal biopsy is an important diagnostic procedure in pediatric nephrology practice and can aid in determining the underlying cause of renal disease, decision of therapy, assigning prognosis and monitoring

response to therapy.<sup>1,2</sup> PRB has improved with the advent of USG and automatic spring-loaded gun (Monopty). The MGT has been used widely and found successful due to its simplicity in 84.4-95.4% with an adequacy for diagnosis of 87%-97.5%.<sup>2-4</sup>

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Many reports have shown that MGT under USG is a safe in children.<sup>1,3,6</sup> However, laparoscopic renal biopsy or open biopsy may be required if PRB fails.<sup>7</sup> It is technically more difficult in children than in adults due to small size, greater mobility of kidneys and lack of cooperation.<sup>2,3</sup> Variation also exists regarding techniques,

sedation/GA, as a daycare or inpatient procedure.<sup>3-6</sup> However, a team of experienced operator, radiologist, renal pathologist and trained staff for monitoring sedation/GA during and after procedure is essential for safety and successful outcome.<sup>8</sup>

There are certain risks associated with technique and sedation/GA. Recent studies have shown a complication rate of 5-30% in different series.<sup>3,4,9</sup> The frequency of gross hematuria ranges from 4-70% in various reports.<sup>3,4,9</sup>

Other complications are hypotension, pain and infection, urinary retention, hydronephrosis, arterio-venous fistula, perirenal hematoma and trauma to other viscera.<sup>2,10</sup> The complications of sedation or GA are respiratory depression, hypoxia, hypotension, anaphylactic reaction and effects of over sedation.<sup>5,11</sup> There are studies from Pakistan on renal biopsies in childhood NS and histopathological pattern of renal disease,<sup>12-14</sup> but to our knowledge, there is no published report on use of MGT, its safety, outcome and complications in pediatric population.

In this study we reviewed our biopsy data with the primary objective to determine the safety, outcome and complication of PRB using MGT under USG. The secondary objective was to compare the results of biopsy under sedation with GA.

## METHODOLOGY

This is a retrospective review of renal biopsies, performed in the departments of Pediatric Nephrology, NICH and KPTI from July 2005 to February 2010. Patients of one month to 16 years with clinical diagnosis of NS, SGN, NNS, CNS and non-nephrotic range proteinuria were biopsied. Children with abnormal coagulation, uncontrolled hypertension, acute infection, solitary kidney and chronic renal failure were excluded. Parental informed consent was taken and institutional committee had approved the use of technique and sedation protocols. Pre-biopsy coagulation profile, complete blood count, renal functions and USG were done in all cases. Children were admitted a day before or on the same day if not already hospitalized.

All patients at NICH received intravenous (iv) sedation following the recent guidelines with few modifications and consisted iv combination of midazolam (0.1-0.3 mg/kg/dose), ketamine (0.5-1 mg/kg/dose), and atropine (0.01mg/kg /dose) along with local 1% xylocaine infiltration. Oxygen (O<sub>2</sub>) was given during the procedure and resuscitation arrangement was available. Vitals including heart rate (HR), respiratory rate (RR), blood pressure (BP) and oxygen saturation (O<sub>2</sub> S%) before, during and post biopsy were monitored. Patients at KPTI received GA by trained anesthetist. The vitals were monitored before and during the procedure by

anesthetists and post biopsy by nurses at frequent intervals during next 24 hours.

Automated spring-loaded biopsy needle 18-G with 17 mm specimen cut notch (Bard Monopty C.R. Bard, Inc US) was used to obtain renal tissue at both centers following the standard techniques.<sup>2</sup> Two to 4 attempts were made to obtain minimum of two tissue cores. During procedure, hypoxic events, apnea requiring intubation and ventilation, hypotension, cardiac arrhythmias, postponement of procedure were recorded. Post biopsy complications such as hypotension, severe pain at biopsy site, gross hematuria, hematoma, blood transfusion, surgical intervention and death if any, were also noted. Inability to get renal tissue on 3 to 4 attempts was labeled as technique failure and content failure as if the tissue was inadequate for pathologist to make diagnosis or <8 glomeruli on light microscopy.<sup>1-4,8</sup> Adequacy was defined as one in which the pathologist could make a confident histological diagnosis and usually it includes > 8 glomeruli.<sup>2,8</sup>

Data including age, sex, indications, place of biopsy, type of sedation /GA, pre- and- post biopsy vitals, number of attempts per patient, number of tissue core, number of glomeruli per biopsy, number of successful, failed or inadequate samples, complications during or after PRB if any were recorded.

Statistical analysis was done using SPSS version 15. Numeric variables like age, number of passes and core of tissue, length of tissue, pre- and- post biopsy vitals were expressed as mean  $\pm$  S.D where as categorical variables like gender, place of biopsy, indications and complications, type of sedation-GA and outcome were presented in frequencies and percentages. Paired test was used to compare pre and post vitals and cross-tabulation was done to compare complications at two centers and under of sedation-GA. P < 0.05 was considered as statistically significant.

## RESULTS:

A total of 147 renal biopsies were performed in 145 patients (repeat biopsy in one and one with Wilms' tumor) during the study period. The detailed demographic characteristics are shown in Table I. Male to female ratio was 1.2:1. The mean age was 7.31 yrs + 4.23 years. Most common indication for PRB was NS in 96(65.3%) and its clinical subtypes, steroid dependent and resistant cases. The second group was SGN in 17(11.6%) with, lupus nephritis being the predominant (n-11, 64.7%). Others in SGN group were Henoch-Shonlein Purpura (HSP) nephritis in 3(17.64%) and each one (5.88%) with NS associated with diabetes, hepatitis B virus (HBV) and glycogen storage disease (GSD). Other two important indications for PRB were NNS in 16 (10.9%) and congenital NS in 15(10.2%)

young infants. Two biopsies were performed for persistent non nephritic range proteinuria (NNRP) and one for Wilms' tumor after refusal for open biopsy.

Renal biopsy procedure failed in 5(3.4%) and postponed in one (0.6%) due to respiratory depression and hypoxia during procedure. PRB was successful in 141 biopsies (95.91%) including one for Wilms' tumor. The success rate of obtaining renal tissue was 95.91% (141/147) with diagnostic adequacy of 95.23% (140/147). Table II shows significant change in vitals except oxygen saturation% ( $P = <0.001$ ) after the procedure. Thus, majority of biopsies (126, 86%) were not associated with complications during or immediate after procedure. Majority of biopsies (126, 86%) were safe and free of complications.

Overall 26(17.68%) complications were observed in 21 biopsies (14.28%). Most of complications ( $n=20$ , 76.92%) were technique related where as sedation or GA related (table I) were very few ( $n=6$ , 23 %). There was no significant difference in complications whether performed under sedation (15%) or GA (11.9%). Comparative detailed results at two centers using sedation at NICH and GA at KPTI are shown in Table III. All 5 failed biopsies were from sedation group. Major complications (respiratory depression and hypoxia) were observed in 6(4%) but not different in two groups (sedation 3.8% vs GA 4.7%). One major complication was observed in sedation group that lead to abandoning of procedure. In 2 biopsies (4.76%) major complications occurred in GA group, one was hypoxia requiring oxygen for more than two hours and delayed recovery.

**Table I: Demographic Characteristics of 147 Biopsies**

Characteristics			no/Frequency	Percentage
Place of biopsy and type of sedation	NICH	Sedation	105	71.7%
	KPTI	GA	42	28.57%
Gender	Male		79	54.48%
	Female		66	45.51%
Age Groups (Years)	Mean Age $\pm$ S.D	7.3 $\pm$ 4.3		
	Age Range	0.12-16		
		>5-10	51	35.2%
		>10	41	28%
		<5	50	34.01%
Number of attempts $\pm$ S.D	Mean $\pm$ S.D	2.3 $\pm$ 0.6		
	Range	1-4		
Number of core of tissue	Mean $\pm$ S.D	2.1 $\pm$ 0.6		
	Range	1-4		
Number of glomeruli/biopsy	Mean $\pm$ S.D	27.2 $\pm$ 19.1		
	Range	8-105		
Number of attempts required to obtain adequate tissue		2	94	64%
		3	48	32.65%
		4	4	2.72%
Type of renal tissue		Cortico-medullary	80	56.73%
		Cortical	61	43.26%
Complications (n=26)		GA related	6	23.07%
		Technique related	20	76.92%

NICH = National Institute of Child Health, KPTI = The Kidney Center Postgraduate Training Institute, GA = General Anesthesia & SD = Standard Deviation.

The other one developed clot retention. Also in one case prolonged gross hematuria (more than 24 hours) occurred as well as perirenal hematoma on US found. There was no procedure related death, need of surgical intervention (nephrectomy), severe hemorrhage requiring transfusion or severe pain requiring treatment and none developed biopsy site infection or required

readmission.

**DISCUSSION:**

Renal Biopsy is generally considered more difficult in children than in adults due to smaller size, mobility of kidney and variation in the level of co-operation.<sup>5, 15</sup> There is a large variations in the renal biopsy practice

**Table II: Comparison of Pre and Post Procedure Vitals in 147 Children**

Vitals	Pre biopsy Mean + SD	Post biopsy Mean + SD	P – value
Respiratory Rate/minute	20.19 + 5.22	22.93 + 10.16	< 0.001
Heart Rate/minute	103.17 +18.11	106.75 + 18.69	< 0.001
Systolic BP (mmHg)	113.26 +15.45	115.43 +9.68	0.1930
Diastolic BP(mmHg)	76.27+11.15	78.49 + 12.17	< 0.006
Oxygen Saturation (%)	96.97 +1.57	97.12 +1.86	0.39000

BP= Blood pressure

**Table III: Comparative Results of Renal Biopsies at Two Centers under Sedation Versus GA**

	Total n (%)	Sedation n (%)	G.A n (%)
Number of patients	147(100)	105(71.47)	42 (28.57)
Successful biopsies	141(95.91)	99(94.3)	42(100)
Diagnostic adequacy	140(95.23)	93(94.2)	42(100)
Mean passes to obtain tissue	2.35+6	3(95)	2(100)
Failed/postponed	6(4.08)	6(5.71)	0
Without complication (safe)	126(85.71)	89(89)	37(88.09)
With complications	21 (14.28)	16(15.23)	5(11.9)
Type of Complications			
Transient GH	12(8.16)	10(9.52)	2(4.76)
GH for >24 hrs	2(1.36)	2(1.99)	0
Hematoma	3(2.04)	2(1.99)	1(2.38)
Hydronephrosis	1(0.68)	1(0.5)	0
Urinary retention	1(0.68)	-	1(2.38)
Hypotension	3(2.04)	2(1.99)	1(2.38)
Resp. depression	3(2.04)	1(0.95)	2(4.76)
Postponed	1(0.68)	-	1(2.38)
Total	26 (100)	18(69.23)	8(30.76)

GA=General anesthesia, GH= Gross hematuria

with respect to use of biopsy needle or device, fluoroscopy or US imaging for localization and guidance of target, the use of sedation or GA, procedure by nephrologist or interventional radiologist in various parts of World due to different levels of technological development and socioeconomic situations and lack of evidence base standards. This has been shown in a survey on renal biopsies in 13 pediatric nephrology units of United Kingdom by British Association of Pediatric Nephrology (BAPN).<sup>4</sup> Many reports have shown the safety, success and low complication rates in performing biopsies as outpatient or day-care procedure.<sup>9, 15-20</sup> In our study all biopsies were performed as inpatient procedure, since there is no established primary and community health care system in our country like in the developed countries to take over the care and monitor for post biopsy complications.<sup>3, 9, 15, 18-20</sup>

There was no difference of gender and male to female ratio in our study (1.2:1) is comparable to a study from Saudi Arabia.<sup>10</sup> Children of all age groups were biopsied with a mean age of 7.31 years which is lower than the median age of 11.8 years in the most recent audit.<sup>4</sup> However, this is consistent with a local study from Lahore.<sup>13</sup> The indications for biopsies are consistent with other studies.<sup>6,13,14,16</sup> The high frequency of CNS (10.2%) in our study has not been reported by others reflecting either technical difficulties or lack of interest of pediatric nephrologist.<sup>3,5,9,10</sup> The overall success (95.91%) and failure rate (3.5%) in our study are comparable to other recent studies.<sup>2,4,5,9</sup> The incidence of serious complications of PRB in the literature is variable depending on type of needle and imaging used.<sup>4,9,15-22</sup> Recent acceptable established standard for major complications rate is <5%.<sup>3,4</sup> Our complication rate (17.68%) is also comparable to a recent survey on renal biopsies, the current practice and audit of outcomes by BAPN in which it ranged from 0-30% and among them major were in 10.4%.<sup>4</sup> The major complications of 4% in our study are less than the above quoted survey.

The overall complications rate in our study is also comparable to local study of 35 biopsies showing 17.2% complications rate.<sup>13</sup> Majority of complications (n=20, 76.92%) were technique related and major complications 6(4%) like respiratory depression and hypoxia were not different in sedation versus GA group. Respiratory depression, hypotension and hypoxia were observed in one and same patient which lead to abandoning of procedure. This is also comparable with one study in which gross hematuria was observed in 4% of cases.<sup>3</sup> SGRC were observed in 3.4% (n=5) which is consistent with 7.69% of anesthesia related complications reported in a recent audit on biopsies.<sup>4</sup> More than one

complications (respiratory depression, hypotension, hypoxia) were observed in the one and same patient and one of them necessitated the abandoning of the procedure. One patient developed gross hematuria for > 24 hours as well as hematoma on US. Such a complication is also reported by Hafeez F.<sup>13</sup> No fatality occurred in our study as reported by others.<sup>10, 16, 17, 21-24</sup>

When we compared the outcome and complications at two centers, there was a significant difference in the failure rate since all failures (5) were from NICH. However, there was no significant difference in the overall success rate at two centers. There was no significant difference (P=0.124) in the frequency of sedation-GA related complication but there was significant difference (P=0.023) in the frequency of transient gross hematuria, a technique related complication, which was observed in 8.2% at NICH in contrast to only in one case(2.3%) at KPTI. This child also developed clot retention as well as peri renal hematoma and required iv hydration for 24 hours along with catheterization. Clot retention in three cases has also been reported by Sinha MD et al and in one patient by Hafeez F et al from Lahore.<sup>9,13</sup>

#### CONCLUSIONS:

Percutaneous renal biopsy under USG using MGT is a safe technique for obtaining renal tissue in children. It was successful in 96% of biopsies with diagnostic adequacy of >95%. Overall complication rate was 17.68%. Majority of them were of minor type and were related to procedure rather than to sedation or GA. Our results are comparable to current established standards for renal biopsy in children. Overall, the success rate and complication rates are better in GA than in sedation group. We recommend use of MGT for obtaining renal tissue under USG under iv sedation with strict monitoring during and after the procedure.

#### REFERENCES:

1. Scheckner B, Peyser A, Rube J, Tarapore F, Frank R, Vento S et al. Diagnostic yield of renal biopsies: a retrospective single center review. *BMC Nephrol* 2009;21: 10:11doi:10.1186.
2. Fago AB. Renal Pathology In: Avener ED, Harmoon WE, Naudet P, Yoshikawa N (Eds) *Pediatric Nephrology* 6<sup>th</sup> ed. 2009 ;Springer Vol 124:565-98.
3. Hussain F, Watson AR, Hayes J, Evans J. Standards for renal biopsies: Comparison of in patient and day-care procedures. *Pediatr Nephrol* 2003; 18:53-6.

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| <p>4. Hussain F, Mallik M, Marks SD, Watson AR. Renal biopsies in children: Current practice and audit of outcomes. <i>Nephrol Dial Transplant</i> 2009;1-5</p> <p>5. Olowu WA. Local versus general anesthesia in pediatric renal biopsy: which is associated with better outcome? <i>Saudi J Kidney Dis Transplant</i> 2006;17:25-33.</p> <p>6. Gauthier BG, Mahadeo RS, Trachtman H. Techniques for percutaneous renal biopsies. <i>Pediatr Nephrol</i> 1993;7:457-63.</p> <p>7. Mukhtar Z, Steinbrecher H, Gilbert RD, Deshpande PV. Laparoscopic renal biopsy in obese children. <i>Pediatr Nephrol</i> 2005; 20:495-98.</p> <p>8. Walker PD, Cavallo T, Bonsib SM. The Ad Hoc Committee on Renal Biopsy Guidelines of the Renal Pathology Society. Practice guidelines for the renal biopsy. <i>Modern Pathology</i> 2004;17:1555-63.</p> <p>9. Sinha MD, Lewis MA, Bradbury MG, Webb NJ. Percutaneous real-time ultrasound-guided renal biopsy by automated biopsy gun in children: safety and complications. <i>J Nephrol</i>. 2006;19:41-44.</p> <p>10. Al Rashid SA, AlMugeirein MM, Abdurrahman MB, Elidrissy ATH. Outcome of percutaneous renal biopsy in children: An analysis of 120 consecutive cases. <i>Pediatr Nephrol</i> 1990;4:600-3.</p> <p>11. Cole JC, Wilson S. The work Group on Sedation. Guide lines for monitoring; and Management of pediatric patients during and after sedation for diagnostic and therapeutic procedures. An update. <i>Pediatrics</i> 2006;118:2587-602.</p> <p>12. Baloch GR, Butt TK, Masood MA. Experience of renal biopsy in children. <i>Pak Paed J</i> 2000;24:51-5.</p> <p>13. Hafeez F, Rasool F, Hamid T. Renal biopsy in childhood nephrotic syndrome. <i>J Coll Physician Surg Pak</i> 2002;12:454-7.</p> <p>14. Lanewala A, Mubarak M, Akhter F, Aziz S, Bhatti S, Kazi JI. Pattern of pediatric renal disease observed in native renal biopsies in Pakistan. <i>J Nephrol</i> 2009;22:739-46.</p> | <p>15. Simckes AM, Blowey DL, Gyves KM, Alon US. Success and safety of same day kidney biopsy in children and adolescents. <i>Pediatr Nephrol</i> 2000;14:946-52.</p> <p>16. Kamitsuji H, Yoshioka K, Ito H. Percutaneous renal biopsy in children: survey of pediatric nephrologists in Japan. <i>Pediatr Nephrol</i> 1999;13:693-96.</p> <p>17. Chesney DS, Brouhard BH, Cunningham RJ. Safety and cost effectiveness of pediatric percutaneous renal biopsy. <i>Pediatr Nephrol</i> 1996;10:493-95.</p> <p>18. Davis ID, Oehlschlager W, O'Riordan MA, Avner ED. Pediatric Renal Biopsy: should this procedure be performed in an outpatient setting? <i>Pediatr Nephrol</i> 1998;12:96-100.</p> <p>19. White RHR, Poole C. Day Care Renal biopsy. <i>Pediatr Nephrol</i> 1996;10:408-11.</p> <p>20. Poggio GH, Moraes MC, Malheiros DM, Saldanha LB, Koch VH. Percutaneous ultrasound-guided renal biopsy in children - safety, efficacy, indications and renal pathology findings: 14-year Brazilian university hospital experience. <i>Clin Nephrol</i> 2008;69:417-24.</p> <p>21. Nammalwar BR, Vijay KM, Prahlad N. Experience of renal biopsy in children with nephrotic syndrome. <i>Pediatr Nephrol</i> 2006;21:286-8.</p> <p>22. Demircin G, Deliba A, Erdoan O, Bulbul M, Baysun S, Oksal A, et al. A one-center experience with pediatric percutaneous renal biopsy and histopathology in Ankara, Turkey. <i>Int Urol Nephrol</i> 2009;41:933-39.</p> <p>23. Bohlin AB, Edstrom S, Alamgren B, Jaremko G, et al. Renal biopsy in children: Indications, technique &amp; efficacy in 119 consecutive cases. <i>Pediatr Nephrol</i> 1995; 9:201-3.</p> <p>24. Makadama AA, Akash SA. Safety of percutaneous renal biopsy as an outpatient procedure in pediatric patients. <i>Ann Saudi Med</i> 2006;26:303-5.</p> |
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