Percutaneous Renal Biopsy in Children

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Abstract

The authors studied the percutaneous renal biopsies performed in the Department of Pediatrics, Siriraj Hospital from January 2000 to March 2001 in order to evaluate the safety and benefit of the procedure. Eighty-five patients (90 episodes) were included in the study, aged 7.8± 3.7 year (range 16 months to 16 years), with a male to female ratio of 1.2:1. Nephrotic syndrome (42.3%) and systemic lupus erythematosus (23.5%) were the two most common indications for biopsy. The kidney was localized by ultrasound prior to the procedure in nearly all cases (97.7%). Premedication with Ketamine was adequate in most patients (91.1%). A modified 13 G Vim-Silverman needle was used to obtain 1-4 biopsy cores. The mean number of glomeruli obtained was 44.0±29.9, with failure to obtain renal tissue in 6 episodes (6.6%). Percutaneous biopsy was performed twice in one patient without success and the patient eventually underwent an open biopsy. The most common complication was hematuria (74.4%), of these, gross hematuria was found in 23.3 per cent. Blood transfusion was needed in 2 patients, one of them also needed embolization to control bleeding. Transient hypotension occurred in 1 patient. Transient hypertension occurred in 6 episodes (6.6%). Muscle twitching occurred in 2 episodes and was treated with diazepam intravenously. Hypertension and muscle twitching only occurred in those who received ketamine. The Clinical Benefit Score was 2 (information yielding a definite diagnosis and/or prognosis, alternatively allowing a change in, or support of, therapy) in 89.4 per cent.

It was concluded that the present practice of renal biopsy is safe, with high clinical benefit score. It remains to be studied whether an ultrasound guidance biopsy with a newer biopsy device will lower the incidence of complications even further.

Key word : Renal Biopsy, Clinical Benefit, Complication

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Percutaneous renal biopsy is a well-established method for the diagnosis and management of children with renal disease[1-3]. This procedure has been performed in the Department of Pediatrics, Siriraj Hospital for more than 30 years. The indications for the procedure were similar to others but renal localization and the biopsy technique were slightly different[1-4]. A prospective study of all renal biopsies on native kidneys in pediatric patients (0-16 year) was conducted over a 15-month period (Jan 2000 - March 2001). The aim of the study was to evaluate the safety and diagnostic efficacy of our renal biopsy procedure.

PATIENTS AND METHOD

Patients

All patients undergoing native renal biopsy at the Department of Pediatrics, Siriraj Hospital between January 2000 and March 2001 were included in this prospective study.

Pre and post biopsy monitoring

Patients were admitted at least 1 day prior to biopsy. The pre biopsy workup included a complete blood count, urinalysis and coagulogram. Kidney position, size and structure were evaluated by ultrasound and the skin was marked over the left lower pole prior to biopsy. Vital signs were monitored prior, during and after biopsy. The patients were instructed to remain in a supine position for 12 hours after the procedure. The hematocrit level was determined 6 hours post biopsy and urine specimens were checked for hematuria over the next 2-3 days. The patients remained under observation in the hospital for at least 72 hours. Adverse effects of the medications used and/or the procedure were noted.

Biopsy procedure

The biopsies were performed by a team comprising an experienced nurse, a pediatric resident or pediatric nephrology fellow, and one of 3 pediatric nephrologists. Biopsies were routinely performed in a prone position at the lower pole of the left kidney, under general anesthesia, usually with ketamine. The skin was then sterilized and a small incision made at the skin mark. A no. 22 spinal needle was inserted along the planned tract and puncture of the kidney confirmed by respiratory movements. The biopsy was performed using a 13-gauge modified Vim Silverman needle after reconfirming its location in the kidney by respiratory movements. The biopsy was repeated as necessary to obtain 1-4 biopsy cores. A dressing was placed over the entry site.

Pathology

Renal tissue was divided into three portions and processed by standard pathology techniques for light microscopic (with special stain and immunoperoxidase staining), immunofluorescence, and electron microscopic examination.

Clinical benefit score

The Clinical Benefit was scored according to the information and material yielded[4].

Statistical analysis

Data are presented as mean ± standard deviation.

RESULTS

During the 15-month period, 90 consecutive biopsies were performed on native kidneys in 85 patients aged 7.8 ± 3.7 year (range 16 month to 16 years). Twenty-two patients (25.8%) were less than 5 years old. The male to female ratio was 1.2 : 1. The indications for renal biopsy were classified according to renal syndromes (Table 1). Nephrotic syndrome (42.3%) and systemic lupus erythematosus (23.5%) were the two most common indications. The kidneys were localized by ultrasound and skin marking in 88 episodes (97.7%) and under realtime ultrasound guide in one episode and by plain film in another episode.

Intravenous ketamine alone was adequate in preparing the patients for the procedure in 82 episodes, in 3 episodes midazolam and midazolam with fentanyl had to be added. Lytic cocktail (meperidine and promethazine hydrochloride) was used in 5 episodes due to poorly-controlled hypertension, midazolam was also needed in two of these episodes.

The duration of the procedure from the ketamine injection, or skin preparation in case of lytic cocktail, to obtaining renal tissue was less than 20 minutes in 81 episodes (89.9%).

The complications experienced are shown in Table 2, with hematuria in 67 episodes (74.4%). Of these, gross hematuria was found in 21 episodes (23.3%). Blood transfusion was needed in 2 episodes (patients) due to a markedly decreased hematocrit level following the procedure and one of them also

Table 1. Indications for renal biopsy.

	Patient N = 85	Percentage
Nephrotic syndrome	36	42.3
Steroid responsive	11	12.9
Frequent relapse	11	12.9
Steroid dependent	13	15.3
Congenital	1	1.2
Evaluation and follow-up pathology in collagen disease	21	24.7
Persistent or recurrent glomerular hematuria	15	17.6
Glomerular proteinuria and hematuria	7	8.2
Glomerular proteinuria of unknown cause	1	1.2
Rapidly progressive glomerulonephritis	5	5.8

Table 2. Complications of renal biopsy and premedication.

Complication	Episode N = 90	Percentage
Hematuria	67	74.4
Gross hematuria	21	23.3
Perinephric hematoma	1	1.1
Blood transfusion necessary	2	2.2
Need for surgical/radiologic intervention	1	1.1
Hypotension (Transient)	1	1.1
Hypertension (Transient)	6	6.6
Muscle twitching	2	2.2

needed embolization to control bleeding. Transient hypotension occurred in one patient at one hour after the procedure which responded well to isotonic saline solution 10 ml/kg intravenously. Transient hypertension (in previously normotensive patients) occurred in 6 episodes (6.6%). Muscle twitching without hypertension occurred in 2 episodes (2.2%) and responded to 0.1 mg/kg diazepam intravenously. Both complications were found in patients who received ketamine. No analgesics apart from oral paracetamol were needed to control pain after biopsy.

Failure to obtain renal tissue occurred in 6 episodes (6.6%). In one patient, percutaneous biopsy was performed twice without success and the patient eventually underwent open biopsy. The success rate of the 3 pediatric nephrologists ranged from 87.5-91.1 per cent, whereas, the nephrology fellow and pediatric resident succeeded in 78 per cent and 30 per cent episodes respectively.

The average number of glomeruli available for light microscopic examination was 44.0±29.9. Nine biopsies yielded less than 10 glomeruli (10.7%). The pathological results are shown in Table 3. The Clinical Benefit score of the renal biopsy in the diagnosis and management of renal disease was 2 in 89.4 per cent cases (Table 4). The overall minimum cost (charge) of renal biopsy is about 3,500 baht (including kidney localization by ultrasound, complete blood count, coagulogram, biopsy procedure, histological preparation and interpretation) excluding hospitalization costs.

DISCUSSION

Percutaneous renal biopsy is the most common method of obtaining tissue from the kidney. The technique yielded renal tissue in 93-95 per cent of biopsies with more than 87 per cent of these being adequate[1,3,5,6]. Although diagnostic features could be seen by light microscopy in some renal diseases, biopsies should also be examined by immuno-fluorescent and electron microscopy for the most accurate diagnosis[7]. Indications for renal

Table 3. Renal pathological diagnosis.

	Patient N = 84*	Percentage
Nephrotic syndrome	35	41.6
IgM nephropathy	28	33.3
Minimal change	2	2.3
Focal glomerulosclerosis	1	1.2
Diffuse mesangial proliferation	1	1.2
Diffuse mesangial sclerosis	1	1.2
Membranoproliferative glomerulonephritis type 2	1	1.2
Diffuse membranous glomerulonephropathy	1	1.2
Systemic Lupus Erythematosus	20	23.8
Class I	2	2.4
Class II_b	3	3.6
Class III	2	2.4
Class IV	12	14.2
Class V	1	1.2
Diffuse endocapillary proliferative glomerulonephritis	6	7.1
Minor glomerular abnormality	3	3.5
Highly suggestive of Alport's syndomre	3	3.5
Hemolytic uremic syndrome	1	1.2
Nephritis in Henoch schönlein purpura	8	9.5
Immune complex glomerulonephritis	3	3.5
Mesangial proliferative glomerulonephritis	1	1.2
Diffuse sclerosing glomerulonephritis	1	1.2
No specific change	3	3.5

* Percutaneous biopsy was performed twice in one patient without success.

Table 4. Clinical benefit score[4].

Clinical indication for biopsy	N	Clinical benefit score		
		0	1	2
Nephrotic syndrome	36	1	0	35
Glomerular proteinuria	1	1	0	0
Glomerular hematuria	15	0	3	12
Evaluation & follow-up pathology in collagen disease	21	1	2	18
Glomerular proteinuria & hematuria	7	0	1	6
Rapaidly progressive glomerulonephritis	5	0	0	5
Total	85	3	6	76

* 0, No additional information or insufficient material
1, Additional information of clinical significance for confirming or ruling out kidney disease
2, Information yielding a definite diagnosis and/or prognosis, alternatively allowing a change in, or support of, therapy

biopsy usually included : hematuria, proteinuria, nephrotic syndrome, acute nephritis, acute renal failure, rapidly progressive glomerulonephritis, chronic renal insufficiency, and renal involvement in systemic diseases. Sequential or follow-up biopsy may also be needed to evaluate therapeutic efficacy[3]. The biopsy findings altered diagnoses in half of the cases in one study, and indicated the need for a different apporoach in one-third of patients[8]. A study in adult patients also showed that native renal biopsy resulted in a change in diagnosis and hence treatment in 33 per cent of patients[9]. In another study, the clinical benefit score in relation to the indications for renal biopsy was 2 (information yield-

ing a definite diagnosis and/or prognosis, alternatively allowing a change in, or support of, therapy) in 97 per cent of patients with nephrotic syndrome and 89 per cent of patients with hematuria and proteinuria[4]. A similar clinical benefit score was also found in this study.

Nephrotic syndrome was the most common indication for renal biopsy in the present study as in others[1,10,11]. Biopsy showed minimal change disease and IgM Nephropathy in the majority of Thai children with nephrotic syndrome (Vongjirad A, Sumboonnanonda A, Paisalnant B, et al. unpublished observation) However, in infants or in those with evidence of nephritis (hypertension, hematuria, low serum complement 3, or decreased renal function) or failing corticosteroid therapy, renal biopsy is usually performed. In these patients, renal histology may be helpful in planning long-term treatment as seen in the present study and others[3,4,8].

Renal biopsy due to systemic lupus erythematosus was more common in this study than others and may reflect the prevalence of the disease in Thailand. Studies have shown that renal biopsy findings may be more sensitive than clinical assessment alone in evaluating the severity of renal involvement in SLE[12-14]. Biopsy may also be performed to evaluate therapeutic efficacy, especially the use of cytotoxic drugs in severe lupus nephritis. The severity of renal involvement in other systemic diseases, such as hemolytic uremic syndrome, Alport syndrome, and Henoch-Schönlein purpura may not be apparent without biopsy. Renal biopsy may be considered an urgent procedure in acute renal failure of unknown etiology and rapidly progressive glomerulonephritis in order to make a diagnosis to give a prognosis and help decide appropriate therapy.

Percutaneous renal biopsy in children has been shown to be less traumatic than in adults. Studies have shown a 9.3 per cent mean incidence of macroscopic hematuria in children *versus* a 36.2 per cent in adults, a 9.1 per cent *versus* 31.3 per cent mean incidence of hematocrit reduction of more than 3 per cent, and a mean incidence of 10.9 per cent in children *versus* 65.6 per cent in adults of radiologically detected peri-and intrarenal hematomas[15]. A larger study in children also showed an incidence of 9.6 per cent of macroscopic hematuria and in 16-42 per cent a subcapsular hematoma was detected by ultrasound examination[10]. The incidence of macroscopic hematuria in this study was as high as 23.3 per cent. This may be due to different technique of renal localization and the use of a modified Vim-Silverman needle instead of a Biopty device or Trucut needle. The technique used in the present study yielded more glomeruli than in other studies (44.0±29.9 *versus* 18±12)[10]. Furthermore, the present study included more patients with SLE who might be at increased risk of macrohematuria than others studies[9-11]. Ultrasound examination was not routinely done after biopsy in the present study, so the incidence of perinephric hematoma (1.1%) may be underestimated. It also remains to be studied whether the increased cost of having ultrasound guidance and a newer biopsy device justifies the risk of macrohematuria in these patients.

In summary, the present study demonstrated the efficacy and safety of percutaneous renal biopsy. Intravenous ketamine is convenient, with a low risk of serious complications. The authors suggest that ultrasound guidance with a newer type of biopsy device may result in an even lower rate of complications but the cost benefit of this practice should also be considered.

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การเจาะตัดชิ้นเนื้อไตตรวจในผู้ป่วยเด็ก

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ศึกษาการเจาะชิ้นเนื้อไตในภาควิชากุมารเวชศาสตร์ คณะแพทยศาสตร์ศิริราชพยาบาล ตั้งแต่ ม.ค. 2543 ถึง มี.ค. 2544 เพื่อประเมินความปลอดภัยและประโยชน์ของหัตถการนี้ พบว่าได้ทำการเจาะตัดเนื้อไต 90 ครั้งในผู้ป่วย 85 ราย อายุเฉลี่ย 7.8 ± 3.7 ปี (พิสัย 16 เดือนถึง 16 ปี) ชาย : หญิง = 1.2 : 1

กลุ่มอาการเนโฟรติก (42.3%) และโรคเอสแอลอี (23.5%) เป็นข้อบ่งชี้ที่พบบ่อยที่สุดในการเจาะตัดชิ้นเนื้อไต การหาตำแหน่งไตทำโดยวิธีอุลต้าซาวน์บ่อยที่สุด (97.9%) ยาระงับความรู้สึกที่ใช้บ่อย (91.1%) คือ Ketamine ทางหลอดเลือดดำ ตัดชิ้นเนื้อไตด้วยเข็ม Modified Vim Silverman เบอร์ 13 ได้ glomeruli เฉลี่ย 44.0 ± 29.9 glomeruli และไม่ได้ชิ้นเนื้อไตเลย 6 ครั้ง ในผู้ป่วย 1 รายทำการเจาะตัดชิ้นเนื้อไต 2 ครั้ง แต่ไม่ได้เนื้อไตและต้องไปผ่าตัดเพื่อเอาชิ้นเนื้อไตมาตรวจโดยตรง โรคแทรกซ้อนที่พบบ่อยที่สุดคือ hematuria (74.4%) ซึ่งเป็น macrohematuria 23.3% ผู้ป่วย 2 รายต้องได้รับเลือด เนื่องจากระดับฮีมาโตคริตลดลงมาก และ 1 ใน 2 รายนี้ ต้องทำ embolization เพื่อให้เลือดหยุด นอกจากนั้นพบความดันโลหิตต่ำชั่วคราว 1 ราย ความดันโลหิตสูงชั่วคราว 6 ราย และกล้ามเนื้อกระตุก 2 ราย ประโยชน์ของหัตถการนี้ประเมินโดย clinical benefit score เป็น 2 (ข้อมูลที่ได้ช่วยในการวินิจฉัยโรค และ/หรือพยากรณ์โรค ทำให้เกิดการเปลี่ยนแปลงหรือสนับสนุนวิธีการรักษา) ใน 89.4%

ผู้ทำการศึกษาสรุปว่า หัตถการเจาะตัดชิ้นเนื้อไตในผู้ป่วยเด็กไทยมีความปลอดภัย และได้ข้อมูลที่มีประโยชน์มาก การทำหัตถการนี้โดยวิธี ultrasound guidance และใช้เข็มตัดแบบใหม่อาจช่วยลดภาวะแทรกซ้อนได้มากยิ่งขึ้นไปอีก

คำสำคัญ : การเจาะตัดชิ้นเนื้อไต, Clinical benefit, โรคแทรกซ้อน

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