

Percutaneous ultrasound-guided renal biopsy in children: a single centre experience

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Abstract

Background and aim: The contribution of renal biopsy is of major importance in many renal diseases in children. In our study we aimed to evaluate retrospectively the indications, safety, efficacy and the spectrum of histopathological findings of percutaneous ultrasound-guided renal (PRB) biopsy during a 7 year period as well as to analyze specific groups of renal patients.

Patients and Methods: A total of 84 renal biopsies were performed in 81 children. Demographic data, clinical symptoms at presentation, indications for renal biopsy, laboratory findings, complications of the procedure and histological diagnosis were obtained from all patients who underwent PRB.

Results: The commonest indication for biopsy accounted was steroid resistant, steroid dependent or frequent relapsing idiopathic nephrotic syndrome (INS). Subcapsular hematoma presented 11% of the patients, but none of them needed blood transfusion. Adequate renal tissue sample was obtained in 97.7% of the renal biopsies. In 80% the histopathology revealed glomerular diseases. The most frequent types of biopsy-proven renal diseases were: focal segmental glomerulosclerosis (FSGS) (15%), IgA nephropathy (13.5%), minimal change disease (10%), various stages of lupus nephritis (8.5%), Henoch-Schonlein nephritis (7.5%), membranous glomerulonephritis (7.5%), mesangioproliferative glomerulonephritis (6%), post-infectious glomerulonephritis (6%), hemolytic uremic syndrome (5%), tubulointerstitial nephropathies (3.5%), acute tubular necrosis 2.5%. Among the 28 cases of INS, FSGS accounted for 43%. The leading histopathological pattern found in patients with recurrent episodes of gross haematuria was IgAN (84.5%). Among 7 cases of lupus nephritis, the observed histological types were: IV+V in 3/7, IIIA in 3/7 (43%) and IIB in 1/7.

Conclusions: Our study shows that percutaneous ultrasound-guided renal biopsy is a safe, reliable and effective technique in children. It also provides updated information for childhood renal disease pattern. Hippokratia 2011; 15 (3): 258-261

Key words: Percutaneous ultrasound-guided renal biopsy, renal diseases, children

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Many children with renal diseases can be diagnosed and treated without a biopsy. However, there are cases where the contribution of the renal biopsy is of major diagnostic and prognostic importance. Therefore, percutaneous renal biopsy (PRB) is a routine procedure in pediatric nephrology for the assessment of renal diseases. PRB is generally considered a safe procedure in pediatric patients¹. Moreover, significant epidemiological data for childhood renal disease pattern are available from studies of renal biopsies in different countries²⁻⁶.

In our study we aimed: 1) to evaluate the indications, safety, efficacy and the spectrum of histopathological findings of PRB during a 7 year period in a tertiary pediatric nephrology centre 2) to analyze specific groups of renal patients including those with nephrotic syndrome, gross haematuria and lupus nephritis.

Methods

A retrospective study was conducted based on medi-

cal records from all patients who had undergone percutaneous ultrasound-guided renal biopsy from 2003 to 2009 in a pediatric nephrology tertiary centre. A total of 84 renal biopsies were performed over a period of 7 years in 81 children. Specifically, demographic data (age, gender), clinical symptoms at presentation, indications for renal biopsy, laboratory findings, complications of the procedure and histological diagnosis were obtained from all patients who underwent PRB. Biopsy was performed using gauge-16 or gauge-18 biopsy needles and two cores of tissue were taken each time. We sequentially used the first 4 years the manual tru-cut needle and later the semi automated spring loaded device. Usual screening for coagulation abnormalities including a complete blood count, prothrombin and partial thromboplastin times and renal function tests were performed. Normal results were accepted if these examinations were done within 3 days of the scheduled biopsy. Biopsies were performed blindly under sterile conditions after ultrasonographic localiza-

tion by the radiologists. The patients were kept flat in the supine position for 6 hours and vital signs, haematuria and Hb levels were recorded. Patients were discharged at least 12 hours after the biopsy. All kidney specimens were studied with common and immunofluorescent microscopies. A post-biopsy ultrasound was obtained in 75/81 children. Informed consent was requested by all parents. No transplant biopsies were included.

Statistical analysis

Data were analysed using the Statistical Package for the Social Sciences (Windows version 17.0; SPSS). Descriptive statistics such as percentages, means and median were calculated. $P < 0.05$ was considered of statistical significance.

Results

Over a 7-year period, 84 biopsies were performed in 81 children, 36 boys and 45 girls, aged 1-18 years (mean age = 9.56 years, $SD=3.8$). Among these, 14 (17.5%) were aged under 5 years, 25 (31%) 6 to 10 years, 39 (48%) 11 to 14 years and 3 (3.5%) 15 to 18 years (Figure 1). The male-to-female ratio was 1 to 1.36. The main indication for performing a biopsy was idiopathic nephrotic syndrome (INS) in 28/81 (34.5%) children. Specifically, indications for biopsy in the 28 cases of INS were: steroid resistant nephrotic syndrome (SRNS) in 16/28 (57%), steroid dependent nephrotic syndrome in 9/28 (32%) and frequent relapsing nephrotic syndrome in 3/28 (11%) (Figure 2).

Other indications were recurrent gross haematuria in 13/81 (16%), haematuria with proteinuria in 10/81 (12.5%), persistent microscopic haematuria in 3/81 (3.5%), acute renal failure in 14/81 (17.5%) and systematic diseases with renal involvement such as systemic lupus erythematosus (SLE) in 7/81 (8.5%) and Henoch-Schonlein nephritis (HSN) in 6/81 (7.5%) (Figure 3).

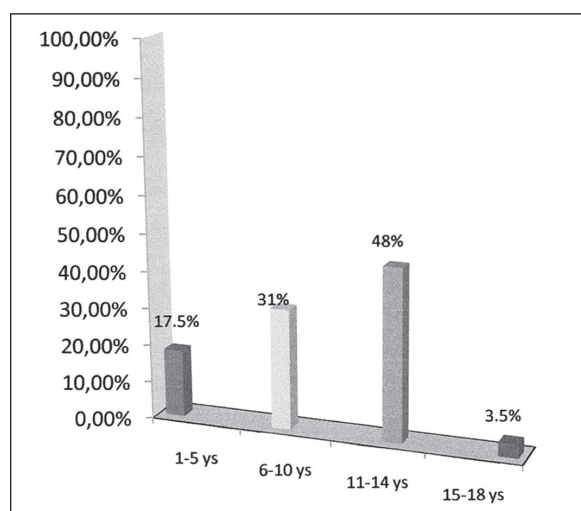


Figure 1: Biopsies performed according to children's age.

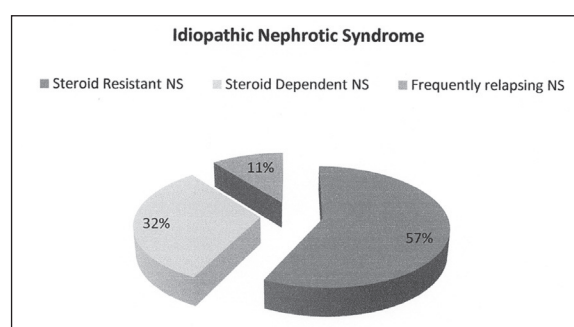


Figure 2: Indications for renal biopsy in children with INS

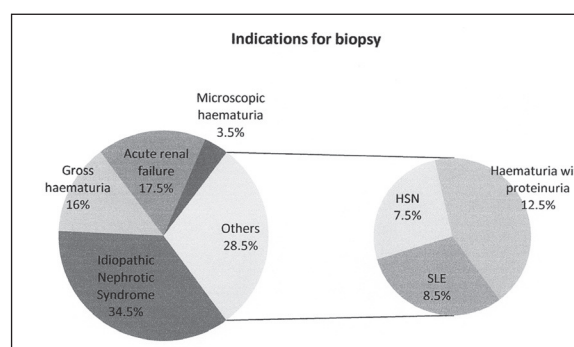


Figure 3: Main indications for renal biopsy

Biopsy was performed under sedation with local anesthesia in 67/81 (83%) patients, and under general anesthesia in 14/81 (17%).

The number of glomeruli was >5 in 7 biopsies and >9 in 75 biopsies. A renal pathology diagnosis was achieved in 70/84 (83.5%) of renal biopsies, while 12/84 (14.2%) were reported as normal. Adequacy of renal tissue sample in number of glomeruli was not obtained for histological diagnosis in 2/84 (2.3%) of the total renal biopsies.

None of our patients presented sedation or biopsy related complications during or after the procedure. 9 out of 81 patients (11%) presented subcapsular hematoma, but none of them needed blood transfusion.

The patterns of histopathological diagnoses are shown in table 1. The most frequent types of biopsy-proven renal diseases were: focal segmental glomerulosclerosis (FSGS) in 12/81 patients (15%), IgA nephropathy (IgAN) in 11/81 (13.5%), minimal change disease (MCD) in 8/81 (10%, 2.5% with IgM deposits), various stages of lupus nephritis in 7/81 (8.5%), HSN in 6/81 (7.5%), membranous glomerulonephritis (MG) in 6/81 (7.5%), mesangio-proliferative glomerulonephritis (MesGN) in 5/81 (6%), post-infectious glomerulonephritis in 5/81 (6%), hemolytic uremic syndrome (HUS) in 4/81 (5%), tubulointerstitial nephropathies (TIN) in 3/81 (3.5%), acute tubular necrosis in 2/81 (2.5%). Alport syndrome was observed in 1 patient (1.2%).

Glomerulopathies were the commonest diagnosis representing 80% (65/81) of all biopsies. Primary glomerulopathies (GN) accounted for 69% (45/65) and secondary glomerulopathies for 31% (20/65). Common

Table 1: Histopathology encountered in kidney biopsies

	n. Patients	%
FSGS	12	15
Minimal change disease with mesangial IgM deposits	8 2/8	10
Mesangioproliferative GN	5	6
MG**	3	3.5
IgA nephropathy	11	13.5
Alport's syndrome	1	1.5
Lupus nephritis stages IV+V	7 3/7	8.5
stage IIIA	3/7	
stage IIB	1/7	
HSN	6	7.5
Tubulointerstitial nephritis	3	3.5
Hemolytic uremic syndrome	4	5
Post-infectious glomerulonephritis	5	6
Acute tubular necrosis	2	2.5
No abnormalities	12	17.5
Total	79	100

*Total was 79 because 2 biopsies yielded an inadequate sample

**MG: Total 6 cases (3 of them due to lupus nephritis)

causes of primary GN were FSGS in 12/45 (27%), MCD in 8/45 (18%) and IgAN in 11/45 (25%). Lupus nephritis and HSN were the most common causes of secondary GN (7/20 and 6/20 respectively).

The histological findings in 28 cases of INS were: FSGS in 12/28 (43%), MCD in 8/28 (28.5%), in 2/8 with IgM deposits), MesGN in 5/28 (18%) and MG in 6/28 (21.5%). In specific, 16 children with SRNS had the following histological findings: FSGS in 8/16 (50%) followed by MesGN in 4/16 (25%), MCD in 2/16 (12.5%) both with IgM deposits and MG in 2/16 (12.5%).

FSGS was the commonest histological finding in children with SRNS. In table 2 is shown the histological findings in nephrotic syndrome by age category. FSGS patients were older compared to other children with SRNS ($p < 0.05$).

Table 2: Histological findings in nephrotic syndrome by age category

	<5 years	6-10 years	11-14 years	15-18 years	Total
FSGS	2	1	8	1	12
MCD	2	3	2	1	8
MesGN	3	0	2	0	5
MG	0	0	3	0	3
Total (cases)	7	4	15	2	28

The leading histopathological pattern found in patients with recurrent episodes of gross haematuria was IgAN in 11/13 (84.5%), while in 2/13 patients renal biopsy was no diagnostic.

Regarding the 7 cases of lupus nephritis, the observed histological types were: membranous GN plus global diffuse GN (IV+V, WHO) in 3/7 (43%), focal proliferative GN (IIIA, WHO) in 3/7 (43%) and minimal mesangial lupus nephritis (IIB, WHO) in 1/7 (14).

Overall 6 children, 2 males and 4 females, aged 11-14 (mean age = 12.3), presented with MG (7.7%). In 5/6 MG was associated with an underlying condition such as D-penicillamine due to Wilson syndrome (1/6), hepatitis B (1/6) and SLE (3/6).

Among our 14 patients with acute renal failure, the most common diagnosis were post-infectious glomerulonephritis in 5/14 (35.5%), HUS in 4/14 (28.5%), TIN in 3/14 (21.5%) and acute tubular necrosis in 2/14 (14.5%).

Discussion

Our study provides data on the indications, safety and efficacy of PRB in children as well as renal disease pattern according to histological lesions detected in our tertiary pediatric renal centre.

Percutaneous ultrasound-guided renal biopsy is safe in children². Its efficacy to reach diagnosis is high. In our centre the failure rate was 2.3% similar with the proportions which have been reported in previous studies^{7,8}.

Nephrotic syndrome, mainly SRNS, in accordance with other studies in children, was the most common indication for renal biopsy^{2,4}. FSGS was noted in 43% of biopsies of INS. Similarly, recent studies showed an increasing incidence of FSGS in children accounted for 31% of biopsies from children with INS^{9,10}. However, the higher incidence of FSGS in our centre could be attributed to the different policies of renal biopsies, especially in INS, from center to center as well as to the fact that as a tertiary centre only mainly difficult cases are referred to us. Our FSGS patients were older than the whole group, which was similar to other studies reporting FSGS to be more common in older patients^{10,11}. Minimal change disease with IgM deposits accounted for 12.5% of cases with SRNS. There is still controversy whether cases with IgM deposits should be regarded as a spectrum of MCD or a completely different entity such as IgM nephropathy. Studies have showed that IgM nephropathy has poorest prognosis and is less likely to respond to steroids compared to MCD^{12,13}. In our series both patients with IgM deposits were presented with SRNS.

IgA nephropathy was the commonest diagnosis among those patients presented with gross haematuria and the second in incidence primary GN in our children. IgA nephropathy is the most frequent glomerulonephritis around the globe, however in large biopsy series its frequency varies widely according to racial/ethnic composition of their population^{8,14}. Regardless the typical clinical presentation in most cases in children, renal biopsy is still the gold standard for its confirmation.

Renal involvement is more frequent in children with SLE than in adults. Children and adolescents represent 15-20% of all systemic lupus erythematosus (SLE) patient¹⁵. However, overall, 60-80% of children with SLE present renal function abnormalities early in the disease course. In 90% of patients, renal disease occurs within two years from disease onset. Clinically significant renal involvement ranges from asymptomatic urinary findings to nephrotic syndrome and renal failure¹⁶. Lupus nephritis in childhood usually presents after the age of 10 years¹⁷. Similarly in our study the age of the children with SLE ranged from 11 to 18. Type IV lupus nephritis was shown to have worse renal survival than other types¹⁸. In our cases, 3 patients presented lupus nephritis stage IV. Therefore, in lupus patients with renal involvement, renal biopsy is very important as a guide to prognostic and therapeutic approaches.

In our study, overall 6 children presented with MG (7.7%). It is of interest to mention the high proportion of MG was observed in our patients, despite of the fact that MG is a rare histologic entity in children, contributing to <5% of cases¹⁹. In children, secondary causes of MG have been associated with conditions such as SLE, hepatitis B or C and Epstein Barr Virus (EBV) infection²⁰⁻²¹. This was also noticed in our study, where our cases were associated with an underlying condition such as D-penicillamine due to Wilson syndrome, hepatitis B and SLE.

There were several limitations in our study. Biopsy specimens were not evaluated by electron microscopy. Moreover the population size was relatively small as our patients were coming from a single centre. Additionally data were collected retrospectively.

Our study shows that percutaneous ultrasound-guided renal biopsy is a safe, reliable and effective technique in children and provides updated epidemiological data regarding renal disease pattern from a pediatric population in a geographic region never reported previously.

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