CHAPTER 4

Paediatric Renal Biopsies

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4.1 Introduction

This chapter reports on renal biopsies done in children less than 15 years of age in Malaysia. Data on native kidney biopsies was collected from 1999 to 2008 in Department of Paediatric Hospital Kuala Lumpur and from 2005 to 2008 for other hospitals.

4.2: Number of patients and renal biopsies

4.2.1: Total number of patients and native renal biopsies

The Registry recorded the diagnosis and clinical data of 809 renal biopsies in 755 children.

4.2.2: Number of patients from various hospitals

The majority of renal biopsies were performed in the Ministry of Health hospitals (Table 4.2.2).

Table 4.2.2: Number of patients from various hospitals

Hospitals	n	%
Hospital Kuala Lumpur	350	46
Other MOH Hospitals	398	53
University Hospital	4	1
Army Hospital	1	0
Private Hospital	2	0
Total number of patients	**755**	**100**

4.2.3: Number of native renal biopsies

With the establishment of Malaysia Renal Biopsies Registry (MRRB) in 2005, more data on renal biopsies were submitted. A total of 164 renal biopsies were performed in 2008 (Table 4.2.3).

Table 4.2.3: Number of renal biopsies

Year	n
1999	44
2000	34
2001	31
2002	31
2003	57
2004	39
2005	128
2006	135
2007	146
2008	164
Total	**809**

4.2.4: Number of renal biopsy done on each individual patient

In the paediatric biopsy group, from 1999-2008, 755 patients had renal biopsy done. 666 patients had renal biopsy for the first time, 69 patients had biopsy done twice, 19 patients had biopsy done thrice and 1 patient had four or more biopsy. Therefore about 12% of patients had a repeat native biopsy done (Table 4.2.4).

Table 4.2.4: Distribution of native renal biopsy in patients by number of attempts

Total number of biopsy per patient	n	%
1st episode	666	88
2nd episode	69	9
3rd episode	19	3
>4th episode	1	0
Total no of Patient	**755**	**100**

4.3 Outcome of renal biopsies

4.3.1: Adequacy of renal biopsy for diagnosis

Altogether 770 (95.2%) renal biopsies were assessed to be adequate for diagnosis upon review by nephrologists and histopathologists. A total of 39 (4.8%) biopsies were not conclusive (Table 4.3.1). Thailand, United Kingdom and Japan reported success rates of between 93.4% and 98.7 [1,2,3] . Thus the success rate in the present report is comparable with figures reported by other centers.

Table 4.3.1: Conclusive report

Year	Total number of biopsies	Report conclusive		Report not conclusive	
		n	%	n	%
1999 -2008	809	770	95.2	39	4.8

4.3.2: Number of glomeruli obtained at each biopsy

621 (77.2%) of the biopsies yielded 10 or more glomeruli. The remaining 22.8% reported less than 10 glomeruli (Table 4.3.2).

Table 4.3.2: Number of glomeruli obtained at each biopsy

Year	Total number of biopsies	≥ 10 Glomeruli		< 10 Glomeruli	
		n	%	n	%
1999 -2008	804	621	77.2	183	22.8

* 5 cases with missing number of glomeruli

4.4: Patient characteristics

Table 4.4.1 shows that renal biopsies were performed on 363 (48.1%) boys and 392 (51.9%) girls. The higher number in girls was probably attributed to biopsies among children with systemic lupus erythematous. The mean age at biopsy was 9.4 ± 3.9 years. The racial distribution of the patients was Malay 61.7%, Chinese 19.2%, Indian 7.7% and other ethnic groups 11.4%.

Table 4.4.1: Gender and racial distribution

		n	%
Gender	Male	363	48.1
	Female	392	51.9
	Total	**755**	**100**
Race	Malay	466	61.7
	Chinese	145	19.2
	Indian	58	7.7
	Others	86	11.4
	Total	**755**	**100**

4.5: Clinical presentation

4.5.1: Clinical presentation at biopsy

Nephrotic syndrome was the most frequent clinical presentation accounting for 52.9%. The second commonest indication for performing renal biopsy was nephritic syndrome, which contributed to 14% of cases (Table 4.5.1).

Table 4.5.1: Clinical presentation at biopsy

Clinical presentation	n	%
Asymptomatic urine abnormalities	107	13.2
Nephritic syndrome	113	14
Nephrotic syndrome	428	52.9
Nephritic nephrotic syndrome	69	8.5
Unknown	86	10.6
Missing	6	0.7
Total	**809**	**100**

4.5.2: Renal function at biopsy

Thirty percent of biopsies were performed in the setting of impaired renal function (Table 4.5.2 (a)). Majority of these children had acute kidney injury (59.2%) (Table 4.5.2 (b)).

Table 4.5.2 (a): Renal function at biopsy

Renal function at biopsy	n	%
Impaired	245	30.3
Normal	514	63.5
Not available or missing data	50	6.2
Total	**809**	**100**

Table 4.5.2 (b): Renal impairment at biopsy

Impaired renal function	n	%
Acute	145	59.2
Chronic	96	39.2
Unknown	4	1.6
Total	**245**	**100**

4.5.3 Hypertension at biopsy

About 29% of patients were hypertensive. The most frequent use antihypertensive drug was calcium channel blocker.

Table 4.5.3: Hypertension at biopsy

Hypertension At biopsy	n	%
Present	234	28.9
Absent	565	69.8
Not available or missing data	10	1.2
Total	**809**	**100**
Drug [a]		
ACEI	46	15
Alpha Blocker	18	6
ARB	3	1
B Blocker	22	7
Calcium Channel Blocker	76	25
No drug available	138	46
Total	**303**	**100**

[a] A patient may have more than 1 type of drug

4.6: Diagnosis of paediatric renal biopsies

Lupus nephritis contributed the largest group at 24.8%. This was followed by focal segmental glomerulosclerosis (FSGS) (24.6%). Minimal change disease (MCD) was diagnosed in 17.2% of cases and post-infectious glomerulonephritis (GN) in 9.1%. IgA nephropathy accounted for 4.8% and Henoch Schonlein Purpura 3.1% (Table 4.6).

Table 4.6: Diagnosis of paediatric renal biopsies

	Diagnosis	n	%
1	Lupus nephritis	201	24.8
2	FSGS	199	24.6
3	MCD	139	17.2
4	Post-infectious GN	74	9.1
5	IgA nephropathy	39	4.8
6	Henoch Schonlein Purpura	25	3.1
7	Mesangial proliferative GN non-IgA	18	2.2
8	Advanced glomerulosclerosis	17	2.1
9	HUS/TTP	6	0.7
10	Membranoproliferative GN	8	1
11	Acute tubular necrosis	8	1
12	Vasculitis	5	0.6
13	Membranous nephropathy	6	0.7
14	Chronic interstitial nephritis	3	0.4
15	Acute interstitial nephritis	2	0.2
16	Alport's syndrome	2	0.2
17	Hereditary(others)	1	0.1
18	Malignancy	1	0.1
19	Crescentic GN	1	0.1
20	Idiopathic crescentic ANCA	4	0.5
21	Others	2	0.2
22	Unknown	48	5.9
	Total	**809**	**100**

4.7: Nephrotic syndrome

4.7.1: Renal histopathology diagnosis of children presenting with nephrotic syndrome

Nephrotic syndrome was the clinical diagnosis in 428 biopsies. As shown in Table 4.7.1, FSGS was found in 41.8% and MCD in 28.7%.

Table 4.7.1: Renal histopathology diagnosis of children presenting with nephrotic syndrome

Diagnosis	n	%
FSGS	179	41.8
MCD	123	28.7
Lupus nephritis	64	15
IgA nephropathy	10	2.3
Mesangial proliferative GN non-IgA	11	2.6
Post-infectious GN	6	1.4
Others*	19	4.4
Unknown	16	3.7
Total	**428**	**100**

* (membranous nephropathy, membranoproliferative GN, Henoch Schonlein Purpura, HUS/TTP, vasculitis, hereditary renal disease, acute interstitial nephritis, chronic interstitial nephritis, advance glomerulosclerosis)

4.7.2: The histopathological profile in different steroid response categories

At biopsy, the clinical response to steroid treatment in children with nephrotic syndrome was recorded. 24.1% (47/ 195) were steroid responsive. Majority of patient with steroid responsive nephrotic syndrome had MCD (44.7%). This was followed by FSGS (31.9%). Among children with steroid resistant syndrome, FSGS was the most common underlying renal pathology (Table 4.7.2).

Table 4.7.2: The histopathological profile in different steroid response categories

Diagnosis	Steroid responsive		Steroid resistant	
	n	%	n	%
FSGS	15	31.9	85	57.4
MCD	21	44.7	28	18.9
Lupus nephritis	4	8.5	6	4.1
IgA nephropathy	0	0.0	2	1.4
Mesangial proliferative GN non-IgA	1	2.1	6	4.1
Post-infectious GN	6	12.8	6	4.1
Others*	0	0.0	9	6.1
Unknown	0	0.0	6	4.1
Total	**47**	**100.0**	**148**	**100.0**

* (membranous nephropathy, membranoproliferative GN, crecentic GN, Henoch Schonlein Purpura, HUS/TTP, vasculitis, hereditary renal disease, acute interstitial nephritis, chronic interstitial nephritis, advanced glomerulosclerosis)

4.8: Renal histopathology diagnosis of children presenting with nephritic syndrome

Renal biopsy was performed in 113 children with nephritic syndrome. The majority demonstrated post-infectious GN (36.3%), while the others had lupus nephritis (30.1%), IgA nephropathy (6.2%) and Henoch Schonlein Purpura (5.3%) (Table 4.8).

Table 4.8: Renal histopathology diagnosis of children presenting with nephritic syndrome

Diagnosis	n	%
Post-infectious GN	41	36.3
Lupus nephritis	34	30.1
IgA nephropathy	7	6.2
Henoch Schonlein Purpura	6	5.3
FSGS	5	4.4
MCD	3	2.7
Messangial proliferative	3	2.7
Acute tubular necrosis	3	2.7
Others*	3	2.7
Unknown	8	7.1
Total	**113**	**100**

* (Systemic vasculitis, Idiopathic crescentic, Alport's syndrome)

4.9: Causes of acute renal failure

The causes of acute renal failure were post-infectious GN (26.2%), lupus nephritis (26.2%) and FSGS (9.7%). 4.8% of children thought to have acute renal failure were found to have advanced glomerulosclerosis on biopsy (Table 4.9).

Table 4.9: Causes of acute renal failure in children who underwent renal biopsy

Diagnosis	n	%
Post-infectious GN	38	26.2
Lupus nephritis	38	26.2
FSGS	14	9.7
Advanced glomerulosclerosis	7	4.8
HUS/TTP	6	4.1
Acute tubular necrosis	6	4.1
MCD	5	3.4
Acute interstitial nephritis	3	2.1
IgA nephropathy	3	2.1
Others*	12	8.3
Unknown	13	9
Total	**145**	**100**

*(membranoproliferative GN, mesangial proliferative GN non-IgA, crescentic, Idiopathic crescentic GN, Henoch scholein purpura, vasculitis, malignancy)

4.10: Paediatric focal segmental glomerulosclerosis and minimal change disease

4.10.1: Characteristics of paediatric focal segmental glomerulosclerosis and minimal change disease among children with steroid resistant nephrotic syndrome

There was no difference in terms of age at presentation, race and gender in children with FSGS or MCD. The urine albumin excretion and creatinine clearance at biopsy was similar (Table 4.10.1).

Table 4.10.1: Clinical characteristics of children with steroid resistant nephrotic syndrome

Clinical characteristics	FSGS	MCD	p value
n	85 (75.22%)	28 (24.78%)	0.4311
Mean age (year)	7.4	6.7	0.4311
Median age (year)	7.5	6.2	
Race			
Malay	59(69.41%)	16(57.14%)	
Chinese	8(9.41%)	6(21.43%)	
Indian	9(10.59%)	3(10.71%)	
Others	9(10.59%)	3(10.7%)	
Total	85	28	0.3883
Gender			
Boy	48(56.47%)	20(71.43%)	
Girl	38(28.57%)	8(28.57%)	0.1612
Gross haematuria			
Present	1(1.18%)	1(3.57%)	
Absent	36(42.35%)	14(50%)	
Not available	48(56.47%)	13(46.43%)	0.3563
Hypertension			
Present	25(29.41%)	6(21.43%)	
Absent	60(70.59%)	22(78.57%)	0.4122
Family history			
Yes	2(2.35%)	1(3.57%)	
No	79(92.94%)	26(92.86%)	
Unknown/ missing	4(4.71%)	1(3.57%)	0.2583
eGFR ml/min/1.73m²			
GFR <30	4(4.71%)	0 (0%)	
GFR 30-60	14(16.47%)	2(7.14%)	
GFRl 60-90	8(9.41%)	4(14.29%)	
GFR > 90	59(69.41%)	22(78.57%)	0.344
Dialysis required			
Yes	1(1.18%)	0(0%)	
No	80(94.12%)	26(92.86%)	
Unknown	4(4.71%)	2(7.14%)	0.7283

Table 4.10.1: Clinical characteristics of children with steroid resistant nephrotic syndrome (cont.)

Clinical characteristics	FSGS	MCD	p value
24HUP g (n, mean)	n=26, 3.73	n=5, 1.75	
Urine albumin mg /m²/H (n, mean)	n=23, 197.7	N=4, 145.1	0.6355
Albumin g/L (n, mean)	n=81, 21.04	n=27,25.56	0.4575
Histology			
Tubulointerstitial disease			
Yes	4 (4.71%)	1(3.57%)	
No	81(95.29%)	27(96.43%)	0.8002

1 Mann Whitney test , 2 Pearson Chi^2, 3 Fisher Exact , 4 Test of proportion
** Calculated Glomerular filtration rate (ml/min/1.73m²) base on Schwartz Formula

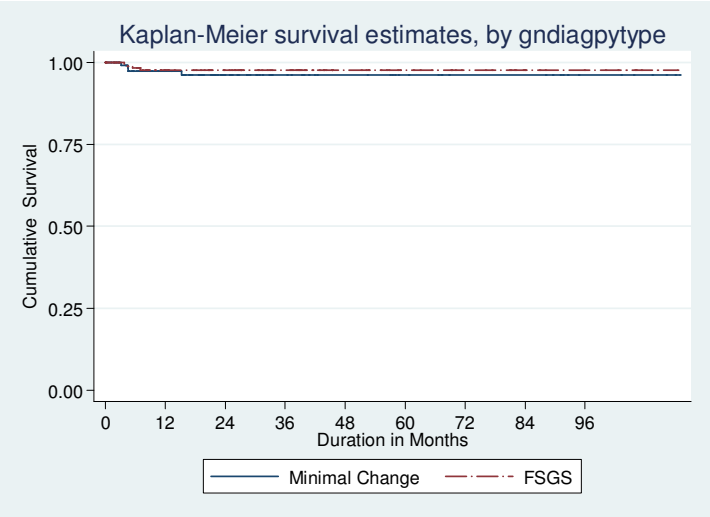
4.10.2: Patient survival in focal segmental glomerulosclerosis and minimal change disease

Table & Figure 4.10.2 shows that patient survival was similar for both MCD and FSGS; 96-97% at 3 years and 5 years from the time of renal biopsy.

Table 4.10.2: Patient survival for focal segmental glomerulosclerosis and minimal change disease

Interval (months)	Minimal change disease			FSGS		
	n	% survival	SE	n	% survival	SE
0	127	100	-	190	100	-
12	92	97.4	0.02	141	97.6	0.01
24	47	96.1	0.02	108	97.6	0.01
36	31	96.1	0.02	78	97.6	0.01
48	23	96.1	0.02	52	97.6	0.01
60	18	96.1	0.02	40	97.6	0.01
72	13	96.1	0.02	30	97.6	0.01
84	13	96.1	0.02	18	97.6	0.01
96	7	96.1	0.02	14	97.6	0.01

Figure 4.10.2: Patient survival by focal segmental glomerulosclerosis and minimal change disease



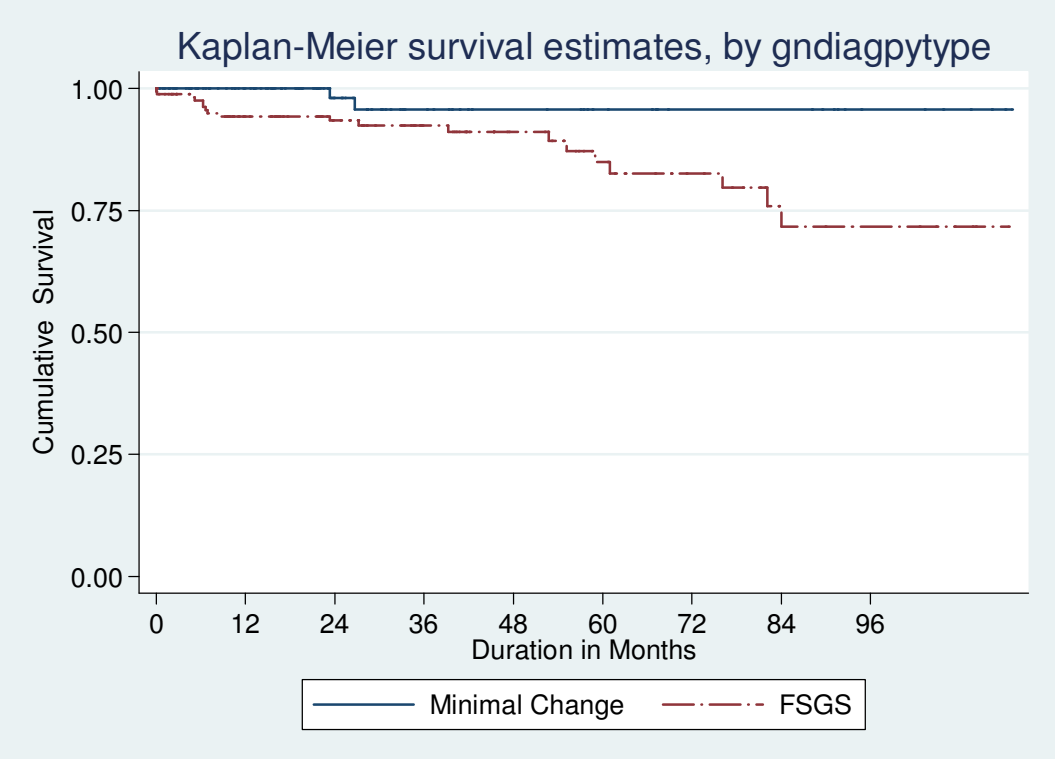
4.10.3: Renal survival of patient with focal segmental glomerulosclerosis and minimal change disease

The renal survival data was extracted from the Malaysia Dialysis Transplant Registry. Table 4.10.3 and Figure 4.10.3 show that FSGS has poorer renal survival; 92.4% and 84.6% at 3 years and 5 years respectively. Renal survival for MCD at 3 years and 5 years remained at 95.7%.

Table 4.10.3: Renal survival of patient with focal segmental glomerulosclerosis and minimal change disease

Interval (days)	Minimal change disease			FSGS			
	n	% survival	SE	n	% survival	SE	p-value
0	115	100	-	170	100	-	0.012
12	86	100	-	131	94.3	0.89	
24	47	98.0	0.02	103	93.4	0.88	
36	31	95.7	0.03	75	92.4	0.87	
48	23	95.7	0.03	49	91.0	0.84	
60	18	95.7	0.03	38	84.6	0.74	
72	13	95.7	0.03	29	82.3	0.70	
84	13	95.7	0.03	17	70.8	0.53	
96	7	95.7	0.03	14	70.8	0.53	

Figure 4.10.3: Renal survival by focal segmental glomerulosclerosis and minimal change



4.11: Paediatric Lupus Nephritis

4.11.1: Total number of patients and renal biopsies

There were 204 renal biopsies performed for 182 children with lupus.

4.11.2: Number of renal biopsy done on each individual patient with lupus

154 patients had renal biopsy for the first time. About 15% of patients had a repeat native biopsy done (Table 4.11.2).

Table 4.11.2: Distribution of renal biopsy in patient with lupus by number of episodes / attempts

Total number of biopsy per patient	n	%
1st episode	154	85
2nd episode	24	13
3rd episode	4	2
>4th episode	0	0
Total Patient	**182**	**100**

4.11.3: Patient characteristics of paediatric lupus nephritis

The female: male ratio was 6.3:1 reflecting the preponderance of lupus in females. The racial distribution for paediatric lupus nephritis was Malay (61%), Chinese (26.4%), Indian (4.9%) and others (7.7%). The mean age of children with lupus nephritis at the time of biopsy was 11.5 ± 2.8 years.

4.11.4: Extra renal manifestation of paediatric SLE

The most common extra renal manifestations among 180 children were cutaneous involvement (malar rash in 63.3%, photosensitivity in 38.9%, oral ulcers in 28.9% and discoid rash in 5%. This was followed by haematological involvement in 60.6%, joint involvement in 26.7%, serositis in 13.3% and cerebral involvement in 13.3% (Table 4.11.4(a)).

In Hong Kong, prolonged fever was the most common extrarenal manifestation (55%). Fever was unfortunately not captured in our database. The other common features were malar rash, polyarthritis and haematological involvement [4]. 160 cases (78%) fulfilled 4 or more ARA criteria at presentation (Table 4.11.4(b)).

Table 4.11.4(a): Clinical presentation of paediatric lupus

Clinical presentation	n	%
Total number of patient	180	100
Malar rash	114	63.3
Discoid rash	9	5
Photosensitivity	70	38.9
Oral ulcers	52	28.9
Arthritis	48	26.7
Serositis	24	13.3
Cerebral	24	13.3
Hematological	**109**	**60.6**

Table 4.11.4(b): ARA criteria at presentation

Number of ARA criteria	n	%
<4	44	22
≥ 4	160	78
Total	**204**	**100**

4.11.5: Classification of paediatric lupus nephritis

All renal biopsies were reviewed and classified according to WHO or ISN/RPS Classification. Class-IV or V+IV lupus Nephritis was found in 131 (64.2%) patients. Less frequent findings were class-III or V+III (16.7%), II (7.4%), V or V+II (6.4%) and VI (1%) lupus nephritis. (Table 4.11.5)

Hong Kong reported 54% in class IV.[4] Thailand reported 48.8% in class IV and 30.5% in class II. [5]

Table 4.11.5: Classification of paediatric lupus nephritis

WHO/ISN /RPS Class	n	%
Class I	0	0
Class II	15	7.4
Class III or V+III	34	16.7
Class IV or V+IV	131	64.2
Class V or V+II	13	6.4
Class VI	2	1
Unknown	9	4.4
Total	204	100

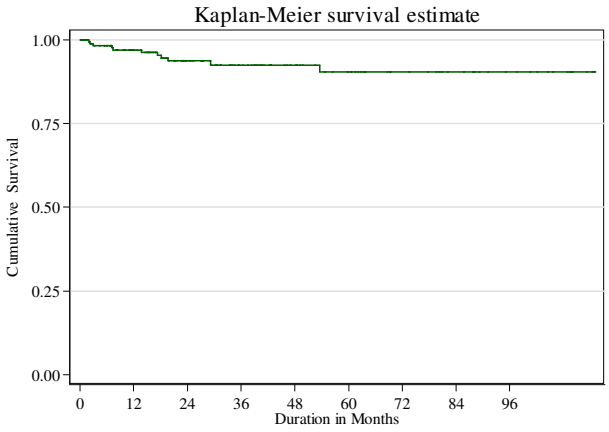
4.11.6: Patient survival in lupus nephritis

Table & Figure 4.11.6 shows that patient survival was 92.6% at 3 years and 90.5% at 5 years from the time of renal biopsy.

Table 4.11.6: Patients survival in lupus nephritis

Interval (months)	Lupus Nephritis patients		
	n	% survival	SE
0	184	100	-
12	135	97.0	0.01
24	92	93.7	0.02
36	68	92.6	0.02
48	50	92.6	0.02
60	38	90.5	0.03
72	27	90.5	0.03
84	21	90.5	0.03
96	**15**	**90.5**	**0.03**

Figure 4.11.6: Patient survival in lupus nephritis



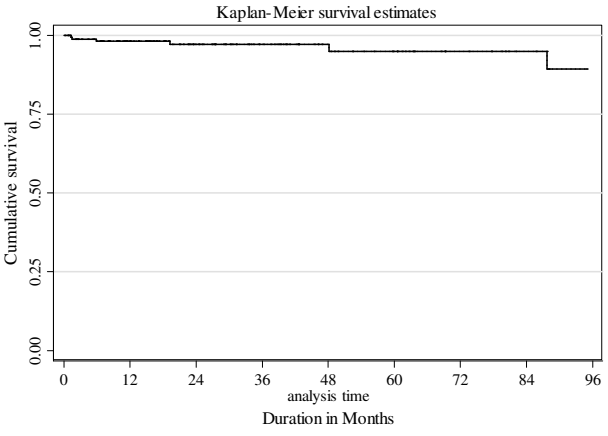
4.11.7: Renal survival of patient with lupus nephritis

Table & Figure 4.10.7 shows that renal survival was 97.1% at 3 years and 5 years from the time of renal biopsy.

Table 4.11.7: Renal survival of patient with lupus nephritis

Interval (months)	Lupus Nephritis patients		
	n	% survival	SE
0	164	100	-
12	122	98.0	0.01
24	88	97.1	0.01
36	64	97.1	0.01
48	46	97.1	0.01
60	36	97.1	0.03
72	25	94.9	0.03
84	19	94.9	0.03
96	15	89.4	0.06

Figure 4.11.7: Renal survival of patient with lupus nephritis



4.12: Renal outcome

Of the 755 patients biopsied, 61 children were reported to the Malaysian Dialysis and Transplant Registry with end stage renal disease[6] .FSGS is the most common known cause of end stage renal disease accounting for 37.7%. This was followed by lupus nephritis (13.1%), advanced glomerulosclerosis (9.8%), post-infectious GN (6.6%) and IgA nephropathy (6.6%). Two patients with minimal change and one patient with acute tubular necrosis progressed to end stage renal disease

Table 4.12: Causes of end stage renal disease in children who underwent renal biopsy

Causes	n	%
FSGS	23	37.7
Lupus nephritis	8	13.1
Advance gloemrulosclerosis	6	9.8
Post-infectious GN	4	6.6
IgA nephropathy	4	6.6
Systemic vasculitis	3	4.9
Membranoproliferative GN	2	3.3
Chronic interstitial nephritis	2	3.3
Minimal change	2	3.3
Mesangial proliferative GN non-IgA	1	1.6
HUS/TTP	1	1.6
Acute tubular necrosis	1	1.6
Idiopathic crescentic	1	1.6
Unknown	3	4.9
Total	**61**	**100**

4.13: Biopsy failure and complications

4.13.1: Risk factors for biopsy failure

The definition of biopsy failure is biopsy which yields less than 10 glomeruli. There was no significant difference in success of renal biopsy with regards to age, real time ultrasound guidance and previous failed biopsy. This is probably because of the small number of data reported and small number of failed renal biopsies (Table 4.13.1).

Table 4.13.1: Risk factors for biopsy failure

Factors	n	Number of failure	Risk ratio	95% CI	p value
Age (years)					
≤2	35	0	-		
>2-≤5	107	1	1.19	(0.40, 3.57)	0.759
>5-≤10	236	0	0.63	(0.32, 1.26)	0.192
>10 (ref*)	431	8	-		
No real-time guided ultrasound	74	2	0.56	(0.21, 1.49)	0.243
Real-time guided ultrasound (ref*)	20	7	-	-	-
Unknown	2	0	-	-	-
Previous failed biopsy	9	8	0.47	(0.05, 4.54)	0.514
Successful biopsy (ref*)	90	85			
Uncooperative patient**	6	1	-	-	-
Cooperative patient (ref*)	93	8			

4.13.2: Complications

As shown in Table 4.13.2, complications were reported in 5.4% of biopsies. The most common complication was bleeding, which occurred in 4.1% biopsies. Seven patients had perirenal haematoma. Blood transfusion was needed in 7 patients. There was one reported case of arteriovenous fistula post biopsy. None of the patients needed either surgical or radiological intervention. There were no cases of loss of kidney or death in association with biopsy procedure.

United Kingdom reported complications rate of 12%.[(2)] Macroscopic haematuria was recorded in 7%. One patient required a single blood transfusion. The overall complication rate in Japan was 5.8%. Gross haematuria occurred in 2.7% and large perirenal hematoma in 0.9% of cases. [(3)]

Table 4.13.2: Frequency of complications

	n	**%**
Total number of biopsies	809	
Total number of complications	44	5.4
Type of complication		
Bleeding	33	70.2
- Gross haematuria	31	93.9
- Haematoma	1	3
Perirenal collection	7	14.9
Infection	0	0
Arteriovenous malformation	1	2.1
Hypotension	1	2.1
Others	3	6.4
Unknown	2	4.3

4.13.3: Risk factors for complication

The risk of complication post renal biopsy was higher in those who had lower GFR and renal failure requiring dialysis. The risk is lower in those who had less than 2 passes of the biopsy needle. Age, hemoglobin level and lupus nephritis were not found to have significant impact on complication rate (Table 4.13.3).

Table 4.13.3: Risk factors for complication

Factors	n	Number of complication	Hazard ratio	95% CI	p value
Age (years)					
≤2	35	3	1.86	(0.51, 6.76)	0.348
>2-≤5	107	10	2.13	(0.95, 4.77)	0.065
>5-≤10	236	10	0.90	(0.41, 1.97)	0.799
>10 (ref*)	431	21	-	-	-
Renal failure					
needed dialysis	64	10	2.39	(1.12, 5.12)	0.025
not needed dialysis (ref*)	632	34	-	-	-
Unknown[a]	113	0	-	-	-
Calculated GFR					
<15 ml/min/1.73m²	56	9	3.28	(1.38, 7.78)	0.007
15-<30 ml/min/1.73m²	42	2	0.90	(0.28, 1.80)	0.888
30-<60 ml/min/1.73m²	162	6	0.71	(0.20, 4.04)	0.468
60-<90 ml/min/1.73m²	122	6	0.96	(0.37, 2.47)	0.931
≥90 ml/min/1.73m² (ref*)	427	21	-	-	-
Hemoglobin (Hb) level					
Hgb ≤8g/dL	21	1	1.05	(0.13, 8.40)	0.963
Hgb >8-≤10g/dL	150	11	1.37	(0.66, 2.82)	0.399
Hgb ≥11g/dL (ref*)	610	31	-	-	-
Unknown[b]	28	1	-	-	-
Not realtime ultrasound guided	359	26	0.63	(0.32, 1.25)	0.184
Ultrasound – Realtime guided (ref*)	125	14	-	-	-
Unknown[c]	30	2	-	-	-
Plug biopsy **	4	0	-	-	-
Not plug biopsy (ref*)	452	36			
Unknown[d]	58	6	-	-	-
SLE	130	9	0.77	(0.36, 1.66)	0.505
Non SLE (ref*)	384	33			
Needle size					
14G	23	2	0.90	(0.20, 4.00)	0.895
16G (ref*)	411	38	-	-	-
18G	75	1	0.13	(0.02, 0.95)	0.044
Unknown[e]	5	1	-	-	-

Table 4.13.3: Risk factors for complication (cont.)

Factors	n	Number of complication	Hazard ratio	95% CI	p value
Number of passes					
≤2	293	18	0.49	(0.26, 0.96)	0.036
3 ≤ 4 (ref)	181	21	-	-	-
≥ 5	14	2	1.23	(0.26, 5.88)	0.795
Unknown[f]	26	1	-	-	-

** Not able to do analysis due to the small sample size
a No information on renal failure needed dialysis for biopsy procedure data
b No information on haemoglobin (Hgb) level for biopsy procedure data
c No information ultrasound biopsy for biopsy procedure data
d No information on plug biopsy for biopsy procedure data
e No information on needle size for biopsy procedure data
f No information on number of passes for biopsy procedure data

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