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An Analysis of 4,514 Cases of Renal Biopsy in Korea

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To evaluate the distribution and changing patterns of renal diseases in Korea, a total of 4,514 cases of renal biopsy collected over a 23-year period between 1973 and 1995 were reviewed. Of 4,200 cases excluding 314 unsatisfactory biopsies, adult cases comprised 59.5% and pediatric cases, 40.5%. The male to female ratio was 1.5:1 in adults and 2.2:1 in children. Glomerulonephritis (GN) comprised 80.0% of the total. The most common primary GN in adults was minimal change disease (MCD) (26.6%), followed by IgA nephropathy (IgAN) (22.1%), membranous GN (MGN) (11.8%), and membranoproliferative GN (MPGN) (5.9%). In children, the primary GN incidence rates were MCD (24.8%), IgAN (10.3%), poststreptococcal (including postinfectious) GN (PSGN) (8.6%), and focal segmental glomerulosclerosis (FSGS) (4.0%). The most common secondary GN in adults was lupus nephritis and in children Henoch-Schonlein purpura nephritis. The most common cause of nephrotic syndrome was MCD in both adults and children, followed by MGN and FSGS. The elderly, aged sixty years and older, comprised 2.7% of cases and recorded equal numbers of MCD and MGN. The proportion of the biopsies found to be seropositive for HBs antigen was 27.9%, and these showed either MGN or MPGN pattern. Repeat biopsy was performed in 168 patients, due to previous biopsy failure in 15.5%. When the primary GN cases were analyzed at 5-year intervals, the prevalence of PSGN, which was greater than 25% during the 1973-1982 period, decreased abruptly in children thereafter, whereas the prevalence of FSGS increased slowly since the 1988-1992 period in both adults and children. The decrease of PSGN and the increase of FSGS suggest a role for socioeconomic and environmental factors in Korea.

Key Words: Elderly, focal segmental glomerulosclerosis, glomerulonephritis, hepatitis, poststreptococcal glomerulonephritis, repeat biopsy

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INTRODUCTION

The prevalence of biopsy-proven glomerulonephritis (GN) varies according to geographic areas, socioeconomic conditions, race, age, and indications for renal biopsy. Some diseases have a high prevalence in indigenous populations: type II diabetes mellitus has a high prevalence in Pima Indians[1] and focal segmental glomerulosclerosis (FSGS) in African Americans.[2] Some diseases are stable, but others change over time: IgA nephropathy (IgAN) is known as the most common GN worldwide and is relatively stable in its prevalence,[3] whereas the prevalences of poststreptococcal glomerulonephritis (PSGN)[4] and membranoproliferative glomerulonephritis (MPGN) have decreased,[5] while that of FSGS has increased.[6-8] Moreover, new entities and variants of glomerular disease emerged in the 1990s, which may reflect changes in the environment. However, little information on the causes underlying this change is available and is mostly reported from the western countries.

In 1991, we reported a retrospective study of 2,361 renal biopsy cases between 1973 and 1988, showing that minimal change disease (MCD) and IgAN were the most common primary GN both in adults and children and that a relatively high proportion of hepatitis B-virus (HBV) was associated with GN in Korea.[9] Koreans have a relatively homogenous ethnicity, and their socioeconomic conditions improved rather rapidly from the 1960s through 1980s, attributed to the successful implementation of economic development plans. Furthermore, our renal laboratory has been a major referral center, since 1970s, receiving

renal biopsies from a total of 24 university hospitals and general hospitals located nationwide. As the number of collected biopsy samples had nearly doubled by the end of 1995, since the first report,[9] in this present study we aimed to analyze the prevalence and changing patterns of GN examined between 1973 and 1995 according to age, sex, and time period in Korea.

MATERIALS AND METHODS

Patients

A total of 4,514 renal biopsies, 3,911 cases from Yonsei University Medical Center (YUMC) and 603 cases from outside hospitals, examined over a 23-year period (1973 to 1995 inclusive) at the Department of Pathology, Yonsei University College of Medicine, were retrospectively analyzed in this study. The cases were divided into 5-year intervals for the assessment of changing patterns, except for the last period, which was restricted to 3 years (1993-1995 inclusive). The first renal transplantation was performed in YUMC in 1978 but allograft biopsies have been actively applied since 1992. Since the renal biopsy program was started in 1973, the number of renal biopsy cases increased from 298 during the period of 1973-1977 to 939, 976, 1,046 during each consecutive 5-year period thereafter and 1,295 in the 3 years 1993-1995. Outside cases comprised 30.2% of the total for the first 5-year period, then gradually decreased to 21.2, 13.9, 11.2 and 7.4% in each of the following consecutive 5-year periods as newly trained renal pathologists and renal laboratories emerged. Biopsy samples were obtained mostly by Tru-cut or Vim Silverman needle in the 1970s and 1980s and by the spring-loaded biopsy gun since mid-1992.

Renal biopsy

Indications for renal biopsy were nephrotic syndrome, acute and chronic nephritic syndrome, acute renal failure, and asymptomatic urinary abnormalities in native kidneys, while for secondary GN, heavy proteinuria and creatinine elevation were the main indications. Indications for renal allograft biopsy were an increase in serum creatinine, significant proteinuria, or persistent microscopic hematuria. There was no significant change in biopsy policy during the study period.

Renal biopsy was processed for light, immunofluorescent and electron microscopy in all submitted cases. Electron microscopy was performed in selected cases, in which diagnosis was not definite by light and/or immunofluorescent microscopy. For light microscopy, the process consisted of formalin-fixed, paraffin-embedded 4 ㎛ thick sections stained with hematoxylin and eosin, periodic acid-Schiff, and trichrome until August 1985. From September 1985 to June 1992, renal tissue was plastic embedded, cut to 1-2㎛ thick, and stained with hematoxylin and eosin, periodic acid-Schiff, trichrome, and methenamine silver methods. From July 1992, renal tissue was paraffin-embedded, cut to 2-3㎛ thick, and stained with acid fuchsin orange G instead of trichrome stain. For immunofluorescent microscopy, a portion of fresh renal tissue was frozen, cut to 4㎛ thick, and stained with FITC-conjugated IgG, IgA, IgM, C3, C4, C1q and fibrinogen (Hyland Laboratories Inc., Costa Mesa, CA, USA and Meloy Laboratories Inc., Springfield, VA, USA in the 1970s and early 1980s, and Dako Inc., Glostrup, Denmark in the late 1980s and 1990s). For electron microscopy, a portion of fresh renal tissue was immersion-fixed in glutaraldehyde, post-fixed with osmium tetroxide, routinely processed, and stained with uranyl acetate and lead citrate. Excluded from the analysis were 314 cases, including 11 allograft biopsies, which did not contain glomeruli. The biopsies were classified according to the modified WHO classification.[10] Cases with HBs antigenemia were not categorized separately, but were classified according to their histological pattern. Allograft biopsy was classified according to the Banff schema.[11] Cases with more than one diagnosis were categorized according to the main diagnosis.

Clinical data

Clinical information was obtained mostly from the biopsy requisition forms, and by reviewing the medical charts, when available. The detection

of HBs antigen was achieved by the double diffusion method between 1973 and 1979, and has been by radioimmunoassay since 1980. For the evaluation of the causes of nephrotic syndrome, information was only available for the last 7 years of the study, 1989-1995. Patients younger than 15 years were classified as children, and those 15 years or older were classified as adults. Patients aged sixty years and older were selected for the evaluation of GN in the elderly.

Statistics

The Cochran-Armitage trend test was used to determine the significance of differences in the prevalence of primary GN according to time period. A p-value less than 0.05 was considered significant.

RESULTS

Of 4200 cases, excluding the 314 unsatisfactory biopsies, adults comprised 59.5% and children 40.5%. The male : female ratio was 1.5:1 in adults and 2.2:1 in children. GN occupied 80.0% of the total (Table 1).

Table 1. Distribution of 4514 Cases of Renal Biopsy

Disease	No. of cases (%)
Glomerular disease	3616 (80.0)
Primary GN	2586 (57.3)
Secondary GN	440 (9.7)
Hereditary nephritis	69 (1.5)
Normal or minor change	521 (11.5)
Tubulointerstitial disease	95 (2.1)
Vascular disease	27 (0.6)
End stage kidney	21 (0.5)
Others	49 (1.1)
Renal allograft	392 (8.7)
Unsatisfactory	314 (7.0)
Total	4514 (100.0)

GN, glomerulonephritis.

Distribution of glomerular diseases

Of 2097 cases of glomerular diseases in adults, the incidence rates of primary, secondary, and hereditary nephritis were 82.5%, 9.9%, and 0.4%, respectively, whereas in children, they were 56.7%, 15.9%, and 4.1%, respectively. Normal or minor glomerular change comprised 7.2% in adults and 23.4% in children.

The major primary GN were MCD, IgAN, membranous nephropathy (MGN), and PSGN in descending order of incidence. In adults, the MCD rate was 26.6%, followed by IgAN and MGN, and in children, MCD was also the most common disease followed by IgAN, PSGN, and MGN (Table 2). By patient age, MCD and FSGS were diagnosed mainly in the first three decades, PSGN in the 1st and 2nd decades, IgAN between the 2nd and 4th decades, and MGN between the 4th and 6th decades (Table 3). The sex ratio of primary GN showed a male predominance (Table 4).

The most common secondary GN were Henoch Schönlein purpura (HSP) nephritis, lupus nephritis, diabetic nephropathy, and Wegener's granulomatosis in descending order of incidence. HSP nephritis was prevalent in children, especially in boys. Lupus nephritis showed a female predominance of 9.3:1 in adults, but the incidence between genders was almost equal in children.

Tubulointerstitial and vascular diseases

There were 95 cases of tubulointerstitial diseases including 23 cases of acute tubular necrosis, 24 cases of chronic pyelonephritis, and 27 cases of tubulointerstitial nephritis. The vascular disease category consisted of 27 cases, including benign nephrosclerosis (7), Bartters syndrome (4), scleroderma (2), hemolytic uremic syndrome (2) and preeclampsia (2).

Allograft biopsy

Of 392 cases available for evaluation, 60.2% were chronic rejection, 11.5% acute rejection, and 11.2% de novo or recurrent GN. Cyclosporine nephrotoxicity without accompanying rejection or GN comprised 3.8% and the rest showed nonspecific (12.5%) or normal (0.8%) findings.

Changing pattern of primary GN

The prevalence of IgAN remained stable beginning with the 1978-1982 period in adults and

Table 2. Distribution of Glomerular Disease According to Modified WHO Classification

	Total	Adults			Children			Unstated
	No (%)	Subtotal	M	F	Subtotal	M	F	
Primary glomerular disease								
MCD	927	557 (26.6)	387	170	355 (24.8)	278	77	15
IgAN	627	464 (22.1)	266	198	148 (10.3)	112	36	15
MGN	296	248 (11.8)	170	78	43 (3.0)	34	9	5
PSGN	201	74 (3.5)	38	36	123 (8.6)	81	42	4
FSGS	156	97 (4.6)	62	35	57 (4.0)	40	17	2
MPGN	154	123 (5.9)	85	38	30 (2.1)	14	16	1
MspGN	143	101 (4.8)	55	46	38 (2.7)	22	16	4
Focal GN	18	11 (0.5)	6	5	7 (0.5)	4	3	0
Crescentic GN	11	9 (0.4)	8	1	2 (0.1)	0	2	0
Chronic GN	32	29 (1.4)	19	10	3 (0.2)	2	1	0
Unclassified GN	25	19 (0.9)	15	4	5 (0.3)	3	2	1
Secondary glomerular disease								
Systemic lupus erythematosus	163	134 (6.4)	13	121	28 (2.0)	15	13	1
Henoch Sch?nlein purpura	250	47 (2.2)	29	18	198 (13.8)	133	65	5
Diabetes mellitus	21	21 (1.0)	15	6	0 (0.0)	0	0	0
Wegener's granulomatosis	2	2 (0.1)	2	0	0 (0.0)	0	0	0
Hereditary nephritis								
Alport syndrome	17	2 (0.1)	0	2	14 (1.0)	13	1	1
TMBD	52	7 (0.3)	4	3	45 (3.1)	30	15	0
Normal or minor change	521	152 (7.2)	89	63	334 (23.4)	63	128	35
Total	3,616	2,097	1,263	834	1,430	987	443	89

MCD, minimal change disease; FSGS, focal segmental glomerulosclerosis; PSGN, poststreptococcal glomerulosclerosis; MGN, membranous glomerulonephritis; MPGN, membranoproliferative glomerulonephritis; MspGN, mesangioproliferative GN; IgAN, IgA nephropathy; GN, glomerulonephritis; TBMD, thin basement membrane disease.
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Table 3. Distribution of Primary Glomerular Diseases by Age

Age (%)	<10	<20	<30	<40	<50	<60	<70	<80	Total
MCD	227 (24.9)	238 (26.1)	234 (25.7)	109 (12.0)	42 (4.6)	42 (4.6)	18 (2.0)	1 (0.1)	911
IgAN	68 (11.1)	158 (25.8)	193 (31.5)	123 (20.1)	50 (8.2)	14 (2.3)	6 (1.0)		612
MGN	24 (8.2)	39 (13.4)	39 (13.4)	55 (18.9)	61 (21.0)	53 (18.2)	20 (6.9)		291
PSGN	59 (30.6)	89 (46.1)	21 (10.9)	11 (5.7)	6 (3.1)	7 (3.6)			193
FSGS	31 (20.1)	36 (23.4)	33 (21.4)	22 (14.3)	16 (10.4)	13 (8.4)	3 (1.9)		154
MPGN	14 (9.2)	34 (22.2)	34 (22.2)	33 (21.6)	23 (15.0)	8 (5.2)	7 (4.6)		153
MspGN	25 (17.2)	34 (23.4)	38 (26.2)	30 (20.7)	14 (9.7)	4 (2.8)			145
Focal GN	1 (5.6)	6 (33.3)	4 (22.2)	2 (11.1)	2 (11.1)		3 (16.7)		18
Crescentic GN	2 (18.2)	1 (9.1)	4 (36.4)	2 (18.2)	2 (18.2)				11
Chronic GN	2 (6.3)	4 (12.5)	15 (46.9)	7 (21.9)	3 (9.4)	1 (3.1)			32
Unclassified GN	2 (8.7)	7 (30.4)	3 (13.0)	5 (21.7)	3 (13.0)	3 (13.0)			23

Same abbreviations are used as in Table 2.

the 1983-1987 period in children. The prevalence of PSGN was greater than 25% during the first two 5 year periods in children, then abruptly decreased thereafter, and showed steady decline over the entire study period in adults. The prevalence of FSGS, however, increased slowly beginning with the 1988-1992 period both in adults and in children. Both the decrease of PSGN and increase of FSGS were statistically significant both in adults and in children (Table 5).

Table 4. The Gender Ratio of Primary Glomerular Disease

	M:F (Total)	M:F (Adults)	M:F (Children)
MCD	2.7:1	2.3:1	3.6:1
IgAN	1.6:1	1.3:1	3.1:1
MGN	2.3:1	2.2:1	3.8:1
PSGN	1.5:1	1.0:1	1.9:1
FSGS	2.0:1	2.0:1	1.8:1
MPGN	1.8:1	2.2:1	0.9:1
MspGN	1.3:1	1.2:1	1.7:1
FocalGN	1.3:1	1.2:1	1.5:1
CrescenticGN	2.7:1	8.0:1	0:2
ChronicGN	1.9:1	1.9:1	2.0:1
UnclassifiedGN	2.8:1	3.8:1	1.0:1

Same abbreviations are used as in Table 2.

Table 5. The Distribution and Percentage of Major Primary GN During Each 5-yr Time Period

Period		No. of Cases(%)	MCD	IgAN	MGN	MPGN	FSGS*	PSGN**	CrGN	ChrGN	UnclGN	MspGN	Focal GN
Adults	1973-1977	182	18 (9.9)	24 (13.2)	28 (15.4)	25(13.7)	10 (5.5)	22 (12.1)	2 (1.1)	7 (3.8)	13 (7.1)	31 (17.0)	2 (1.1)
	1978-1982	364	105 (28.8)	109 (29.9)	32 (8.8)	13(3.6)	17 (4.7)	21 (5.8)	3 (0.8)	9 (2.5)	2 (0.5)	51 (14.0)	2 (0.5)
	1983-1987	403	164 (40.7)	110 (27.3)	63 (15.6)	24(6.0)	10 (2.5)	10 (2.5)	0 (0.0)	9 (2.2)	1 (0.2)	10 (2.5)	2 (0.5)
	1988-1992	407	155 (38.1)	113 (27.8)	66 (16.2)	34(8.4)	25 (6.1)	4 (1.0)	2 (0.5)	3 (0.7)	1 (0.2)	2 (0.5)	2 (0.5)
	1993-1995	327	93 (28.4)	98 (30.0)	54 (16.5)	25(7.6)	39 (11.9)	6 (1.8)	2 (0.6)	1 (0.3)	1 (0.3)	3 (0.9)	5 (1.5)
Children	1973-1977	17	1 (5.9)	2 (11.8)	0 (0.0)	1(5.9)	0 (0.0)	6 (35.3)	0 (0.0)	1 (5.9)	3 (17.6)	3 (17.6)	0 (0.0)
	1978-1982	241	91 (37.8)	25 (10.4)	8 (3.3)	6(2.5)	2 (0.8)	79 (32.8)	2 (0.8)	0 (0.0)	1 (0.4)	27 (11.2)	0 (0.0)
	1983-1987	228	100 (43.9)	58 (25.4)	12 (5.3)	13(5.7)	11 (4.8)	26 (11.4)	0 (0.0)	0 (0.0)	1 (0.4)	5 (2.2)	2 (0.9)
	1988-1992	167	82 (49.1)	34 (20.4)	15 (9.0)	10(6.0)	12 (7.2)	7 (4.2)	0 (0.0)	2 (1.2)	0 (0.0)	3 (1.8)	2 (1.2)
	1993-1995	203	101 (49.8)	42 (20.7)	13 (6.4)	3(1.5)	26 (12.8)	12 (5.9)	0 (0.0)	0 (0.0)	2 (1.0)	3 (1.5)	1 (0.5)

Same abbreviations are used as in Table 2.
*p=0.0002 in adults, p<0.0001 in children.
**p<0.0001 both in adults and in children.

Causes of nephrotic syndrome in primary GN

Among 628 cases of primary GN presenting with nephrotic syndrome in the 1989-1995 period, MCD was the most common GN both in adults and in children. In adults, MCD comprised 53.3%, followed by MGN, FSGS, and MPGN in order of incidence. In children, MCD comprised 72.7% followed by FSGS and MGN. The incidence of IgAN presenting with nephrotic syndrome was 4.1% in adults and 1.9% in children (Table 6).

GN associated with HBs antigenemia

Of 524 cases tested for HBs antigen, 146 cases were positive. Most of the HBs antigen positive cases were MGN (29.4%) and MPGN (61.5). Of HBs antigen associated MGN, children comprised 59.6%, of which 87.1% were boys. Twenty-eight cases of MPGN were exclusively found in adults and 85.7% of these were males. The number of cases of MCD and IgAN with HBs antigen positivity were 21 (8.8%) and 20 (7.2%), respectively (Table 7).

Repeat biopsy

Repeat biopsy was performed in 168 patients, from 2 to 5 times, due to either previous biopsy failure in 15.5% or to the need for evaluation of treatment response and follow-up in 84.5%. Most of these cases were HSP nephritis and MCD. Four cases of MCD at the first biopsy showed FSGS in the follow-up biopsy.

Table 6. Causes of Nephrotic Syndrome (1989-1995)

	Adults (%)	Children (%)	Total (%)
MCD	221 (53.3)	152 (71.4)	373 (59.4)
MGN	85 (10.5)	15 (7.0)	100 (15.9)
FSGS	44 (10.6)	26 (12.2)	70 (11.1)
MPGN	38 (9.2)	5 (2.3)	43 (6.8)
IgAN	17 (4.1)	4 (1.9)	21 (3.3)
PSGN	5 (1.2)	2 (0.9)	7 (1.1)
Other primary GN	5 (1.2)	4 (1.9)	9 (1.4)
Congenital nephrotic syndrome	0 (0.0)	5 (2.3)	5 (0.8)
	415 (100.1)	213 (99.9)	628 (99.8)

Same abbreviations are used as in Table 2.

Table 7. Distribution of 146 Cases with HBs Antigenemia

Diseases / Period*	1973-1979	1980-1995	Total
MGN	1	52	53
MPGN	0	28	28
MCD	0	21	21
IgAN	2	18	20
PSGN	0	8	8
Normal or minor change	0	4	4
FSGS	0	4	4
Lupus nephritis	0	2	2
Focal GN	0	2	2
Hemolytic uremic syndrome	0	1	1
End stage kidney	0	1	1
Unclassified GN	0	1	1
Acute tubular necrosis	0	1	1

*The detection of HBs antigen in the serum was performed by double diffusion method between 1973 and 1979 and by radioimmunoassay between 1980 and 1995.
Same abbreviations are used as in Table 2.

Renal biopsy in the elderly

Elderly patients sixty years of age and older provided 72 cases of biopsy, 60 primary GN and 7 secondary GN. Among the primary GN cases, MCD and MGN were the most common diseases (Table 8).

DISCUSSION

GN was the most predominant renal disease in our cases. MCD, IgAN, and MGN were the most common primary GN. MCD was the most common GN and the most common cause of nephrotic syndrome both in adults and in children. The higher prevalence of MCD is a nationwide phenomenon in Korea, and yet is not in western countries, a discrepancy that is difficult to explain. However, it may, in part, be attributed to an improper referral system in Korea. Most of the patients with renal disease visit university hospitals directly, bypassing primary physicians. Patients with nephrotic syndrome tend to visit physicians rather early due to symptoms of sudden increase in body weight and edema where most of them are asked to undergo renal biopsy, whereas the majority of patients with chronic GN do not recognize their illness until they start renal replacement therapy. Therefore, nephrotic cases occupied a significant proportion of the biopsy material in the sample and the data included a higher proportion of less serious diseases. MCD occurred in 72.7% of the cases of nephrotic syn-

Table 8. Renal Biopsy in the Elderly

	No. of cases
Primary GN	
MCD	20
MGN	20
IgAN	6
MPGN	5
FSGS	4
Focal GN	3
PSGN	2
Secondary GN	
Diabetic nephropathy	4
SLE	2
Amyloidosis	1
Tubulointerstitial disease	
Tubulointerstitial nephritis	3
Acute tubular necrosis	1
Others	1
Total	72

Same abbreviations are used as in Table 2.

drome in children and 53.3% in adults. But the proportion decreased to 31.8% in the elderly (≥60 years of age). On the contrary, the prevalence of MGN as a cause of nephrotic syndrome increased from 20% in adults to 40.9% in the elderly. It seems to be universal that MGN is the most common primary GN and the most common cause of nephrotic syndrome in the elderly.[12] The relative proportion of elderly people in the study population may have influenced the prevalence of disease.

The prevalence of IgAN was 26.8% of primary GN in adults and 18.2% in children, similar to that reported in Japan.[13] The high prevalence of IgAN and also of normal histology may be attributed to mass screening of urine in school children and to the aggressive approach in children with hematuria practiced in our institution. As the thickness measurement of the glomerular basement membrane has been a routine procedure in cases with hematuria since 1990 in our laboratory, most of the TBMD cases before 1990 were diagnosed as minimal mesangiopathy or glomerular minor change by light microscopy and were clinically referred to as benign recurrent hematuria. We think that TBMD is not uncommon because the prevalence in Korea was found to be 34.4% in a 1994 study of 90 children with hematuria.[14]

The male : female ratio of primary GN ranged from 1.2:1 to 2.7:1. The male predominance was stronger in children with MCD, IgAN, and MGN than in adults with the same diseases. As compared to another report on an adult population,[15] male predominance was more prominent in MCD, but not notably higher in IgAN.

Compared to the data from the 1970s and 1980s, the prevalence of postinfectious GN, including PSGN, decreased in the 1990s. This reduction may be attributed in part, due to a better control of infection with the improvement of hygiene similar to the situation in Singapore.[4] Nowadays, patients are treated without being referred to major hospitals and only a small proportion undergo renal biopsy, which may have also contributed to the decrease. The prevalence of FSGS gradually increased according to our study, a result in accordance with other reports.[6-8] Increased prevalence of FSGS has been reported regardless of ethnicity,[8] which suggests that socioeconomic and environmental factors play a role in the increase of FSGS. Regarding the milder histologic alteration in recent biopsy material compared to that commonly occurring in the 1970s, the tendency for patients nowadays to seek diagnosis and treatment at an earlier stage may be one factor. Sampling error is another possibility, in which segmentally sclerotic glomeruli may not have been present in the earlier biopsies.

For secondary GN, lupus nephritis was the most common secondary GN in female adults, and HSP nephritis was the most common secondary GN in male children. HBV infection is endemic in Korea, with about 12% of the general population being carriers.[16] HBs antigen positivity was highest in patients with GN of membranoproliferative and membranous patterns. In contrast to the 1.6% prevalence of MPGN in adults without HBs antigenemia,[17] our finding of a prevalence of 5.9%, including the cases with HBs antigenemia, supports a morphologic relationship between secondary MPGN and HBV infection. In children, membranous pattern was predominant, which is in accordance with other reports.[18,19] In a later study we will investigate whether there is a change in the prevalence of MGN and MPGN, using results from the HBV vaccination program in place at our hospital since the 1980s. Although

hepatitis C infection can be another cause of MGN or MPGN,[20] its prevalence is low in the general population.[21] In contrast to the report showing a strong association between IgAN and HBs antigenemia in the endemic area,[22] HBs antigen positivity in IgAN in our study (7.2%) was comparable to that of the general population.

In summary, MCD and IgAN are the most common primary GN in adults and in children. The most common cause of nephrotic syndrome was found to be MCD. However, this proportion decreased as the patients became older. There is still a considerable proportion of HBV-associated GN with features of MPGN in adults and MGN in children. The prevalence of PSGN decreased since the 1980s, whereas the prevalence of FSGS increased in the 1990s. This changing pattern of GN incidence may suggest a role for socioeconomic and environmental factors in Korea.

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