A C U T E G L O M E R U L O N E P H R I T I S

I N P A T I E N T S

A T

KENYATTA NATIONAL HOSPITAL

NAIROBI

1973 - 1981

A Dissertation presented in part fulfilment
for the Degree of Master of Medicine
(Paediatrics) in the University of Nairobi.

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C O N T E N T S:

LIST OF TABLES AND FIGURES

D E C L A R A T I O N

I hereby certify that this Dissertation is my own original work and has not been presented for a Degree in any other University

signed

FREDERICK MUGO NG'ANG'A

This Dissertation has been submitted for examination with my approval as University Supervisor

signed

PROF. S.K. ONGERI

A B S T R A C T

A retrospective analysis was done on 456 patients admitted at Kenyatta National Hospital with acute glomerulonephritis from 1st January 1973 to 31st December 1981. 64% of the 456 patients were children of 15 years and below. 53% of the children were of 3 to 7 years of age. Male to female ratio was 2.4:1. There was no tribal of family predilection to this disease. All cases appeared to be sporadic with a fairly constant annual prevalence. A peak prevalence in the cold months of June to August was noted.

23% of the patients had a history of sorethroat prior to the onset of acute glomerulonephritis. The latent period between the onset of throat infection and the onset of acute glomerulonephritis was 5 to 14 days in 80% of these patients. An additional 16% of the patients had a history of skin infection prior to the onset of acute glomerulonephritis; the latent period in these cases being spread out between 5 and 30 days.

The commonest presenting features were oedema (100% of the patients); macroscopic hematuria (38%); abdominal/loin pain (27%); decreased urine output (25%); cough (17%); Headache (15%); and vomiting (13%). The commonest physical findings were oedema (100% of

the patients) mainly generalised oedema (92%); hypertension (52%); throat infection (14%) and congestive cardiac failure (12%).

61% of 424 patients who had blood urea done had levels of 40 mg/dl and above. 21% of these patients had levels of 100 mg/dl and above. 19% of 406 patients had serum sodium of 134 mmol/l and below. 29% of 413 patients had serum potassium of 5.3 mmol/l and above, 6% of these patients having levels of 6.5 mmol/l and above. 34% of all the patients in the study had albuminuria of 300mg/dl and above. 116 patients had serum albumin below 2g/dl, albuminuria and generalised oedema hence presenting with acute glomerulonephritis with nephrotic syndrome.

Normal commensals of the throat were isolated in 67% of the 83 throat swabs done on admission. Klebsiella, Escherichia coli staphylococcus aureus, streptococcus fecalis and non haemolytic streptococcus pyogenes were isolated from the rest of the throat swabs. 7 patients had skin swab for bacteria done. Staphylococcus aureus was isolated in all of them. Only 174 patients (38%) had antistreptolysin O titres determined on admission. 80% of these 174 patients had titres of 200 international units and above.

10% of 233 patients who had urine culture for bacteria done had bacteriuria of 10^5 colonies/ml. urine grown; predominantly Eschericia coli, and Klebsiella. Anaemia was not a predominant feature.

259 of the 456 patients (57%) were followed up for 1 to 7 years after the onset of acute glomerulonephritis. However, only 23% of the 259 patients were followed up for over one year. The clinical outcome of the 259 patients was as follows:-

	Children	Adults
. Clinical remission	75%	62%
. Deaths	4%	12%
. Nephrotic Syndrome	18%	13%
. Persisting features of ongoing renal disease	3%	13%

Majority of deaths occurred within the first week of admission. Of the patients who developed nephrotic syndrome on followup, only 3 had initially presented with nephrotic syndrome on admission. 2 patients had a suspected second attack of acute glomerulonephritis.

47 out of 456 patients (10%) had renal histology done. Of these 25 (53%) had diffuse proliferative glomerulonephritis; 11 (23%) had rapidly progressive glomerulonephritis; 9 (19%) had membranoproliferative glomerulonephritis and 2 (5%) had focal proliferative glomerulonephritis. 6 of the 11 patients (55%) with

rapidly progressive glomerulonephritis and 4 of the 25 patients (16%) with diffuse proliferative glomerulonephritis died within 7 days of admission. 13 of the 25 patients (52%) with diffuse proliferative glomerulonephritis; 3 of the 9 patients (33%) with membranoproliferative glomerulonephritis, as well as one patient each with focal proliferative and rapidly progressive glomerulonephritis ultimately developed nephrotic syndrome.

INTRODUCTION AND OBJECTIVES:

Acute glomerulonephritis is a clinical syndrome in which haematuria, proteinuria, casturia and leucocyturia are usually present. Systemic hypertension, oliguria, oligosaluria, hypervolaemia, hypocomplementaemia and encephalopathy may or may not be present (5). This syndrome otherwise referred to as acute nephritic syndrome, is due to varying degrees of non bacterial inflammatory disease of the kidneys demonstrable on renal histology. However due to the high recovery rate of patients with acute glomerulonephritis, renal biopsy is not necessary for but a minority of cases. Management of this disease therefore rests on its clinical and laboratory recognition.

Studying the pattern of renal diseases at Kenyatta National Hospital in 1970 to 1976, Ongeri and Otieno (41) found that acute glomerulonephritis and nephrotic syndrome were the leading renal diseases requiring hospitalisation. Otieno and Abdullah (42) had similar findings in their retrospective study of renal disease at Provincial General Hospital, Nyeri, Kenya in 1972 to 1975. Report of acute glomerulonephritis by Carothers (11) at Kakamega, was one of the earliest on this disease in Kenya. In this report, an association between malaria and acute glomerulonephritis was suggested though not verified.

Reports on acute glomerulonephritis in Kenya

are otherwise scanty. However, there has been several reports on the disease at Mulago Hospital, Uganda in the last few decades. Raper (44) analysed 136 necropsies with renal disease in 1947 to 1953. 15 cases (11%) had acute glomerulonephritis on histology. A similar necropsy study by Allison (2) in 1959 to 1961 found no evidence of acute glomerulonephritis in 273 necropsies. He found only 5% of the cases (13 cases) with chronic glomerulonephritis; 42% primary chronic pyelonephritis; 22% secondary chronic pyelonephritis; 5% acute pyelonephritis and the rest, other renal diseases.

Luder (30) saw no clinical case of acute glomerulonephritis in children admitted at Mulago Hospital in 1954 to 1956. However, Musoke (35) reported 8 out of 18 renal cases in an analysis of paediatrics admissions in 1959. A clinicopathological study of 46 children with renal disease was done by Hutt and White (22) in 1960 to 1962, 24 of which had diffuse proliferative glomerulonephritis on renal histology.

In Ethiopia, acute glomerulonephritis has been reported to be the commonest glomerular disease in children (1). Similar pattern has been noted in South Africa (20).

Acute glomerulonephritis has been extensively studied and documented outside Africa. Current knowledge on this disease has emanated largely from long term studies of epidemics of this disease, results of which will be refered to hereinafter in relation to the results of the present study. Most of the epidemics have been poststreptococcal pyoderma acute glomerulonephritis. Notably are the two epidemics at Red Lake Minnesota U.S.A. (24, 43), New York U.S.A. (7), Trinidad (39), and Venezuela, South America (45). Also in record is an epidemic among millitary men at Bainbridge U.S.A. (55) preceded by streptococcal pharyngitis.

In an attempt to fill the gap of the current inadequate documentation of this disease in Kenya, the present study was undertaken to fulfil the following two objectives:-

. To study the pattern of presentation of acute glomerulonephritis at Kenyatta National Hospital.

. To determine the eventual outcome of this disease as reflected in the followup case notes of the patients studied.

METHODOLOGY

Kenyatta National Hospital adopted the World Health Organisation International classification of Diseases on 1st January 1973. Case records of all inpatients with discharge diagnosis of acute, chronic or unspecified glomerulonephritis or nephrotic syndrome who were admitted at the Hospital during the period 1st January 1973 to 31st December 1981 were obtained. 1294 case records were available and were each studied to identify cases of acute glomerulonephritis and to ascertain the correctness of this diagnosis.

456 out of 1294 patients (35%) had acute glomerulonephritis according to the following criteria:-

- Abrupt onset of oedema, within 7 days of admission.
- No history of previous renal disease or ill health suggestive of renal disease.
- Clinical and laboratory findings that:-
  - (a) Support the diagnosis of acute glomerulonephritis and
  - (b) include microscopic haematuria and red blood cell casts and
  - (c) are not consistent with any other systemic disease.

The records of the 456 patients were examined in details and the data obtained tabulated in a proforma which included the following information:-

. Patients identification by name, inpatient number, tribe, sex and age.

. Date of onset of symptom(s) of acute glomerulonephritis.

. Details of presenting symptoms and clinical features on admission.

. Latent period between the onset of throat and skin infections and onset of symptom(s) of acute glomerulonephritis.

. Urinalysis, biochemical, haematological and other relevant laboratory findings.

. Renal histology where available, either from renal biopsy or autopsy material.

. Followup data showing the subsequent clinical course of the disease after the initial attack of acute glomerulonephritis.

The author of this study actively participated in the management of patients with acute glomerulonephritis admitted in the last 15 months of the study, as well as patients turning up for review and/or renal biopsy under the auspices of the Renal Unit of Kenyatta National Hospital. Records of these patients were analysed retrospectively along with the others.

For the purposes of the results, discussion and comparison of the same with others obtained elsewhere, the patients were classified into two groups according to their age:-

. Children : 15 complete years and below

. Adults : above 15 years.

RESULTS

Table 1

Age Distribution of 456 Patients with Acute Glomerulonephritis:

Age (Years)	No.	%
0 - 5	113	25
6 - 10	110	24
11 - 15	68	15
16 - 20	38	8
21 - 25	38	8
26 - 30	50	11
31 - 35	27	6
36 - 40	10	2
41 - 45	2	

Table 1 shows that the majority of patients with acute glomerulonephritis were children. There were 291 children (of 15 years and below) forming 64% of the patients in this study. 49% of all the patients were of 10 years and below.

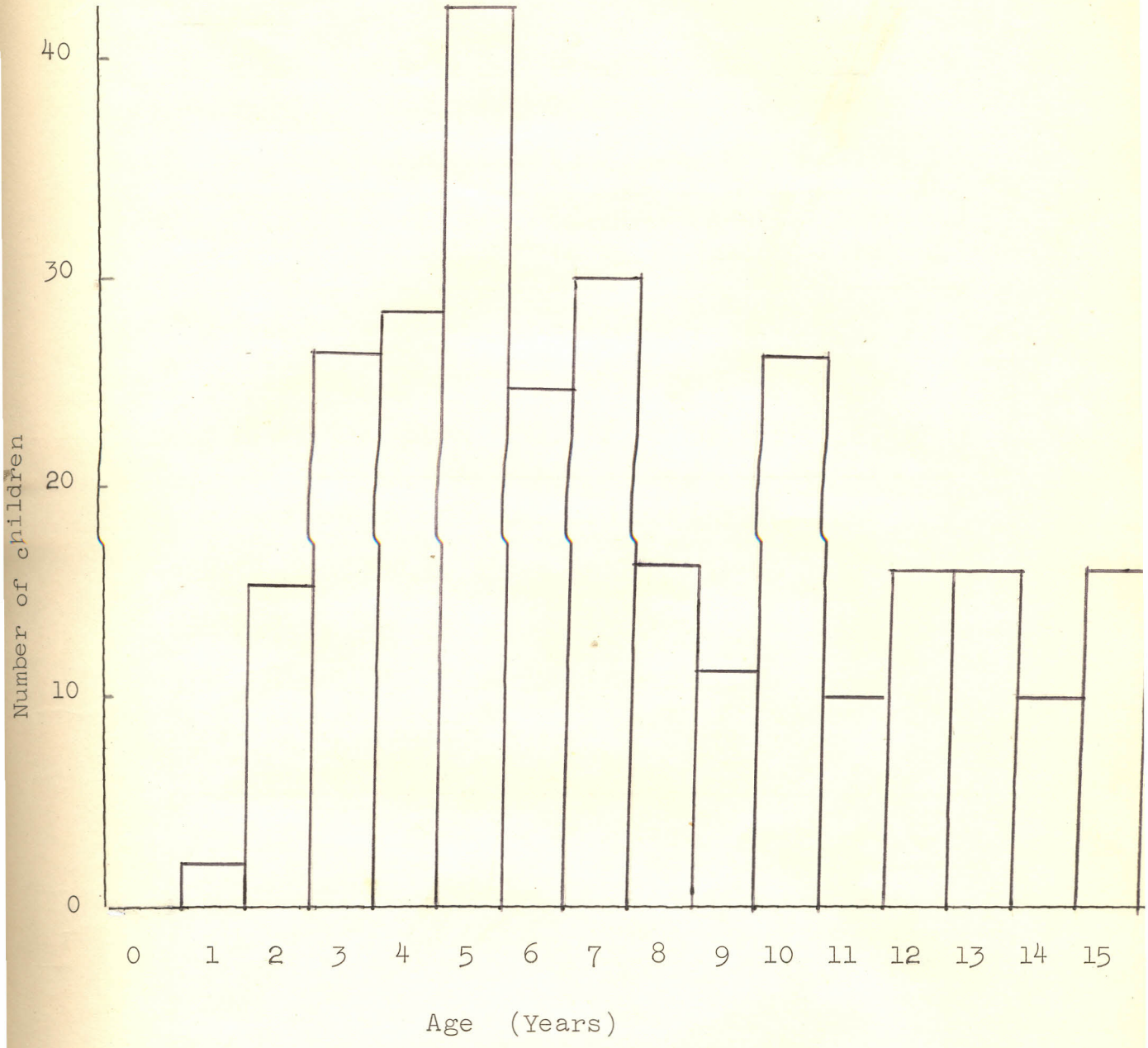

Fig 1 Age Distribution of 291 children with Acute Glomerulonephritis

Fig 1 shows that 53% of the children were of 3 to 7 years of age, this being the peak age of the disease.

Table 2.

Sex Distribution of 456 patients with Acute Glomerulonephritis;

	Children (n=291)	Adults (n=165)	Total (n=456)
Male	176	117	393
Female	115	48	163
Male:Female Ratio	1.5:1	2.4:1	2.4:1

A preponderance of males in both children and adults is noted as shown in Table 2.

Table 3.

Tribe Distribution of 456 Patients with Acute Glomerulonephritis

	Children (n=291)	Adults (n=165)	Total (n=456	%
Kikuyu	184	111	295	66
Kamba	27	23	50	11
Luo	39	8	47	10
Luhya	20	15	35	7
Masai	5	1	6	1
Kisii	3	3	6	1
Others	13	4	17	4

Kenyatta National Hospital serves the residents in Nairobi, Central Eastern and a portion of Rift Valley Province who are often self-refered. Table 3 shows a preponderance of Kikuyu, Kamba and Luo tribe; this being a reflection of the population pattern of Nairobi and its environs.

Table 4

Yearly Occurrence of Acute Glomerulonephritis

	Children	Adults	Total
1973	28	12	40
1974	30	30	60
1975	37	21	58
1976	38	13	51
1977	27	18	45
1978	18	15	33
1979	27	21	48
1980	44	17	61
1981	42	21	60
Total	291	165	456

Table 4 shows the number of cases of acute glomerulonephritis identified per annum in this study. There was no significant difference in the annual occurrence of this disease in the period of study.

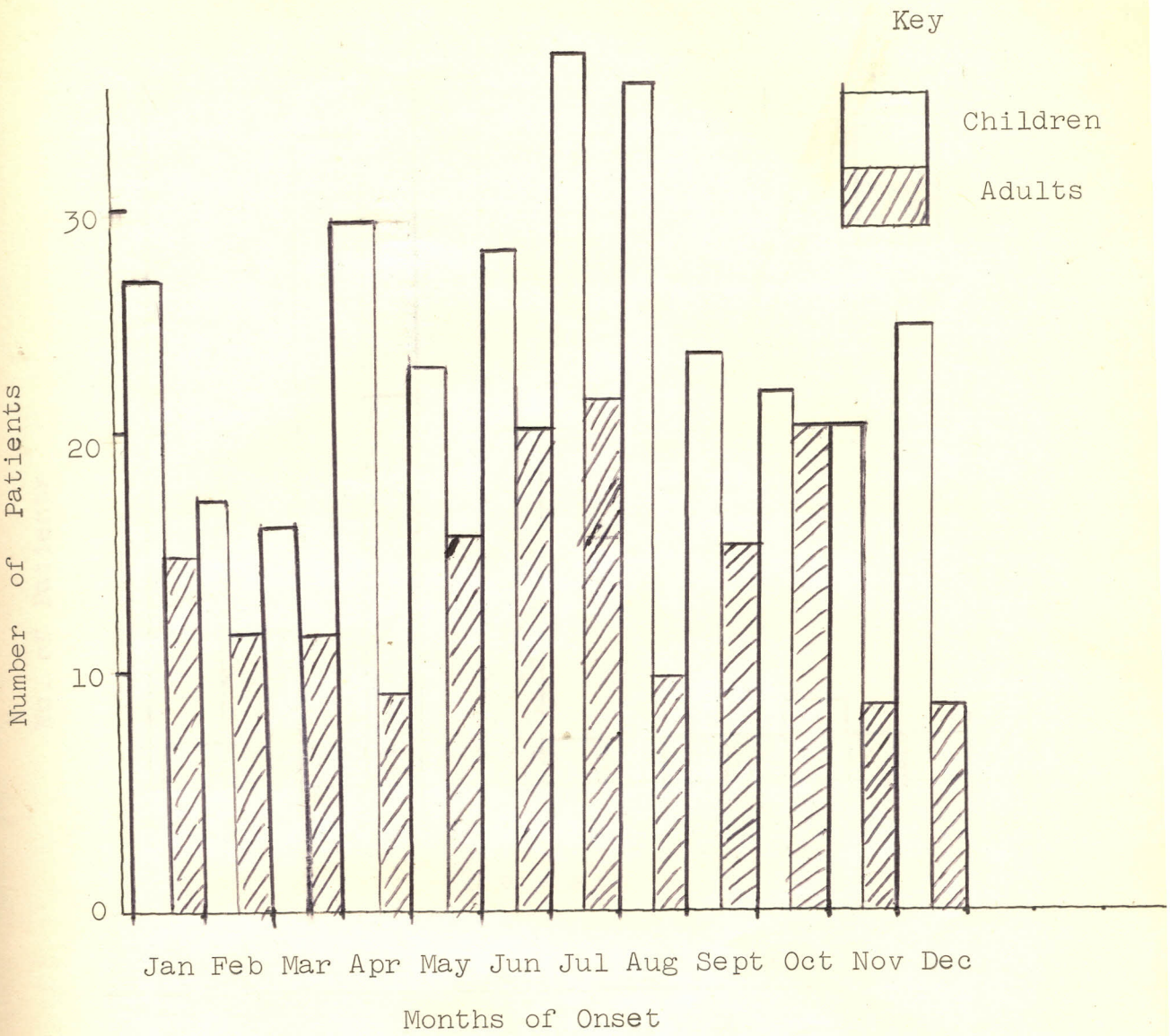

Fig 2. Monthly Occurrence of Acute Glomerulonephritis

There was not a remarkable difference in occurrence of acute glomerulonephritis according to the months. However, a peak prevalence in June to August is noted. These are cold months in Nairobi when the prevalence of respiratory infections especially in children is high.

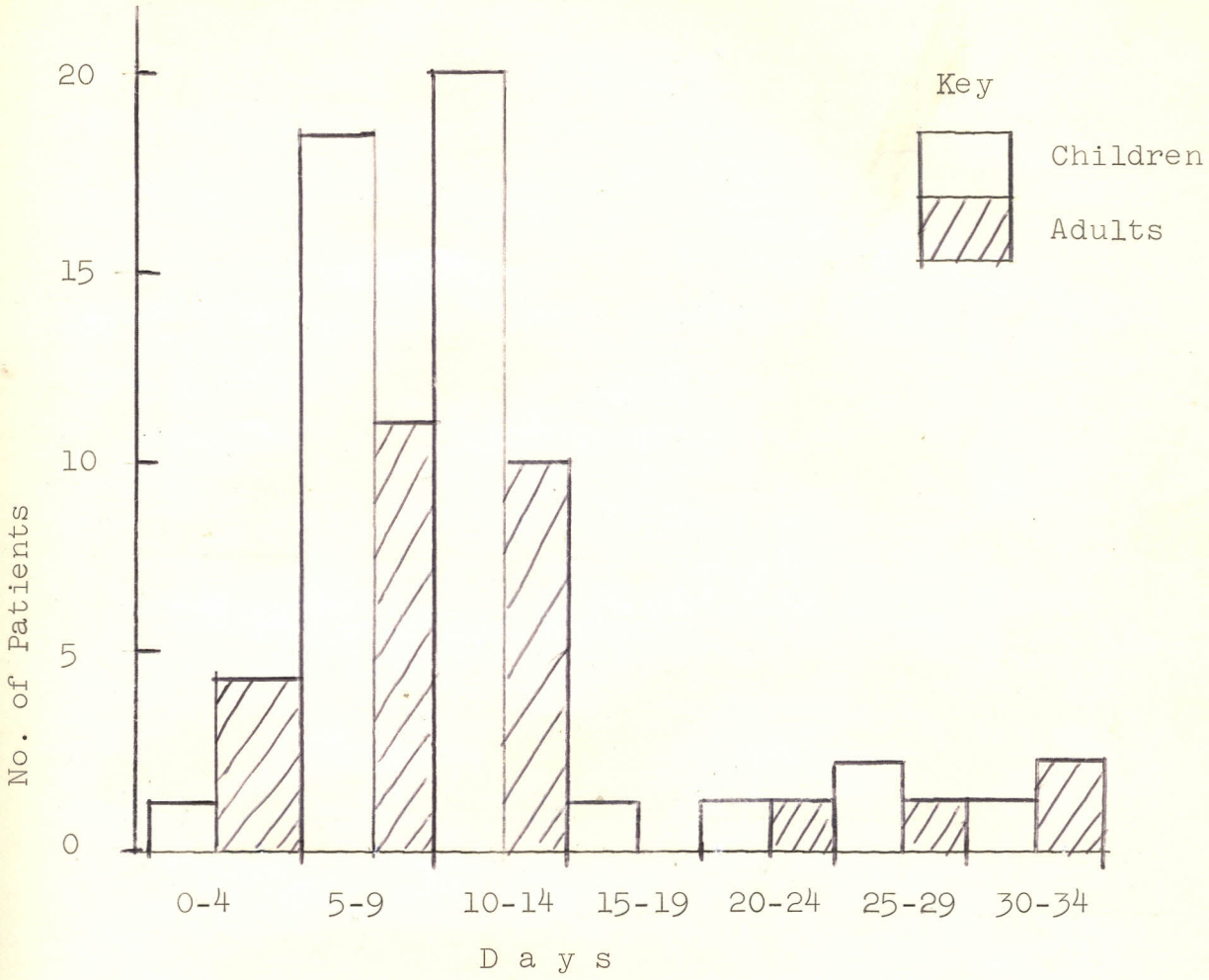

Fig 3: Latent Period Between The Onset of Throat Infection and The Onset of Acute Glomerulonephritis

103 out of the 456 patients (23%) gave a past history of throat infection prior to the onset of acute glomerulonephritis. 67 of these 103 patients were children.

73 out of the 103 patients (71%) gave a specific date of onset of their throat infection. Fig 3 shows that 80% of this group of patients had acute glomerulonephritis 5 to 14 days after the onset of throat infection.

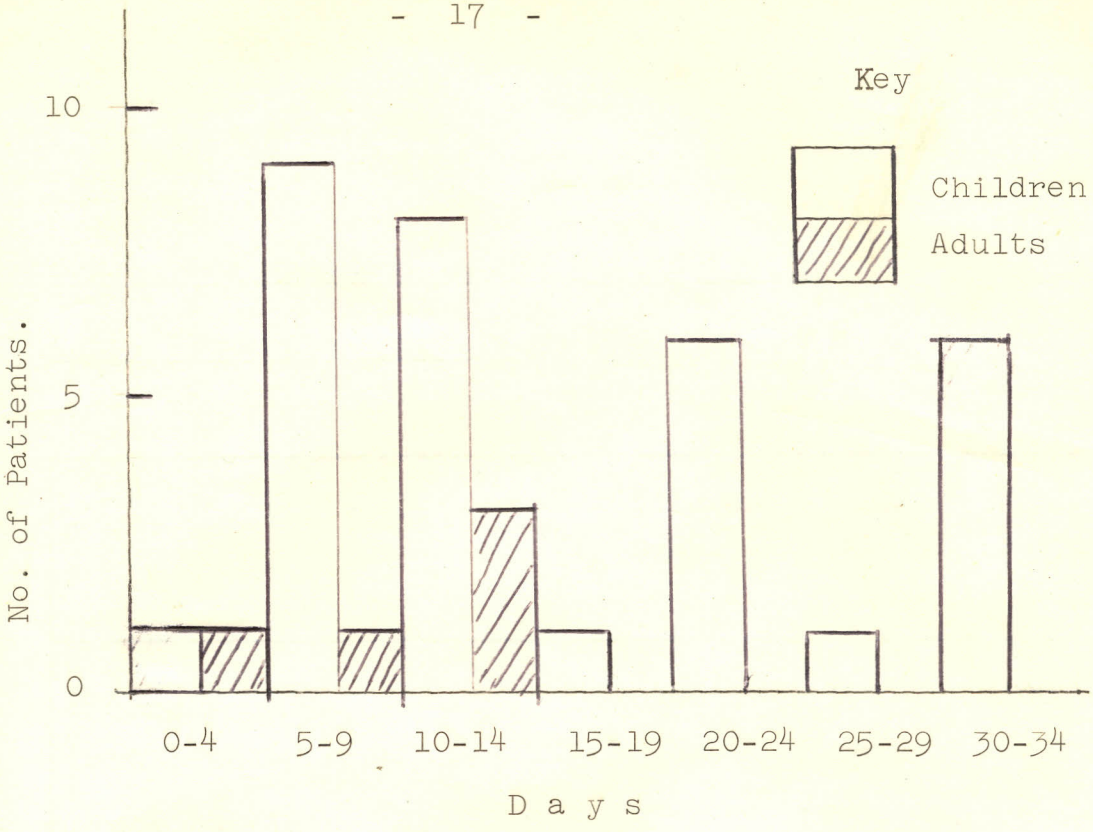

Fig 4: Latent Period Between The Onset of Skin Infection and The Onset of Acute Glomerulonephritis

73 out of the 456 (16%), 9 of these being children gave a past history of skin infection. All of them had either active or healing pyoderma on admission. 4 children had secondary infection following scabies. No adult had had scabies.

Specific date of the onset of skin infection was given by 42 patients, this being 58% of the patients with history of skin infection. The latent period between the onset of skin infection and the onset of acute glomerulonephritis was spread out between 5 and 30 days as illustrated in Fig 4.

Table 5

Presenting Symptoms in 456 patients with Acute Glomerulonephritis

	Children (n=29) %	Adults (n=165) %	Total (n=456) %
Swelling only	100	100	100
Dark/bloody urine	40	35	38
Abdominal/loin pain	19	40	27
Decreased Urine output	24	28	25
Cough	16	19	17
Headache	9	27	15
Vomiting	13	14	13
Epistaxis	9	6	8
Fever	4	9	6
Joint pains	2	5	3
Convulsions	2	1	2

All patients presented with oedema as initial chief complaint; 38% of them having symptoms suggestive of macroscopic haematuria. 40% of the adults had abdominal or loin pain. The proportion of children with this complaint was20% mainly composed of the older children. 92 of the 456 patients (5%) had a recorded 24 hours urine output within the first four days of admission. 70 of them (76%) had decreased urine output to oliguric levels. 52 of the 70 patients were children mainly those of 6 years and above. Oliguria was defined as urine output less than 200 ml in children and less than 400 ml in adult in 24 hours.

Table 6:

Main Physical findings in 456 Patients with Acute Glomerulonephritis

	Children (n=291) %	Adults (n=165) %	Total (n=456) %
Oedema-generalised	90	96	92
-Periorbital	10	4	8
Hypertension	47	58	52
Throat infection	10	10	14
Congestive cardiac failure	11	12	12
Skin Infection	10	7	9
Acute pulmonary oedema	4	11	7
Loin tenderness	4	7	5
Convulsions	1	2	2

Blood pressure was recorded in all patients except 31 children who were 3 years and below. Hypertension was defined as three readings taken within 24 hours of admission which were consistently above 95 percentile diastolic pressure for age in accordance with the standards by the National Heart and Lung Institute (37).

Some patients had secondary skin infection following scabies: 4 out of 9 children with post pyoderma acute glomerulonephritis and 6 out of 67 adults.

Table 7:

Bacteria Culture Results of Throat Swabs

	Children n = 49	Adults n = 34	Total n = 83
Normal flora	30	26	56
Klebsiella	6	3	9
Escherichia coli	6	1	7
Staphylococcus aureus	4	2	6
Streptococcus fecalis	2	2	4
Streptococcus pyogenes	1		1

Throat swabs were done in 83 out of the 456 patients (18%) within 4 days of admission. Normal flora was cultured in 56 out of these 83 patients (67%). Streptococcus pyogenes was isolated in only one child. It was non haemolytic and was not typed.

7 patients, 5 adults and 2 children with skin infection had cultures done within 4 days of admission. In all, heavy growth of Staphylococcus aureus was isolated.

Table 8

Antistreptolysin O Titres (ASOT) in Patients with Acute Glomerulonephritis

	Children	Adults	Total	%
ASOT (international units/ml	n = 48	n = 17	n = 65	100
0 - 199	3	2	5	8
200 - 399	12	8	20	31
400 - 599	6	1	7	11
600 - 799	9	2	11	17
800 - 999	8	0	8	12
1000 and above	10	4	14	21
ASOT (Latex screening test)	n=53	n = 56	n =109	100
Negative	18	7	25	23
Positive	35	49	84	77

A rising titre was demonstrated in 3 children and 1 adult by a repeat ASOT 2 weeks after the first one.

Latex screening test was done when the reagents for accurate titration were not in stock. The screening test is an agglutination test, favourably correlating with the titration test. A positive latex screening test corelated with ASOT of 200 international units/ml or more.

Overall, 174 out of the 456 patients (38%) had ASOT determined by either method 145 of these (80%) had ASOT of 200 international units and above. There was no preselection of patients who had ASOT done.

Table 9

Blood urea in 424 patients with Acute Glomerulonephritis

Blood Urea (mg/dl)	Children (n=268)	Adults (n=156)	Total (n=424)	%
39 and below	111	54	165	39
40 - 99	113	56	169	40
100 - 199	29	32	61	14
200 and above	15	14	29	7

Blood urea was determined in 424 out of the 456 patients (93%) on admission. The method used for determination of blood urea was either the automated carbamido - diacetyl monoxime method or the urostat-method.

Table 9 brings out two important aspects of blood urea in patients with acute glomerulonephritis at Kenyatta National Hospital on admission: 265 out of the 424 patients (61%) had elevated blood urea levels of 40 mg/dl and above while 90 of the 424 patients (21%) had levels of 100 mg/dl and above. The reference range of blood urea for Kenyatta National Hospital is 15 to 40 mg/dl. The pattern of blood urea levels in children and adults was similar.

Table 10

Serum Sodium levels in 406 patients with Acute Glomerulonephritis

Serum Sodium (mmol/l)	Children (n=256)	Adults (n=150)	Total (n=406)	%
134 and below	50	26	76	19
135 - 145	188	114	302	74
146 and above	18	10	28	7

Table 11

Serum Potassium Levels in 413 Patients with Acute Glomerulonephritis

Serum Potassium (mmol/l)	Children (n=263)	Adults (n=150)	Total (n=413)	%
3.7 and below	14	11	25	6
3.8 - 5.2	176	92	258	65
5.3 - 6.4	61	35	96	23
6.5 and above	12	12	24	6

Serum sodium and potassium levels are determined using the flame photometry method at Kenyatta National Hospital, the reference range being 135 to 145 mmol/l and 3.8 to 5.2 mmol/l respectively. Out of the total of 456 patients in this study, 406 (89%) had their serum sodium determined and 413 (91%) had their serum potassium determined on admission.

The levels of these electrolytes in patients in this study are tabulated in Table 10 and 11. 76 out of the 406 patients (19%) had low sodium levels of 134 mmol/l and below while 120 out of the 413 patients (29%) had high potassium levels of 5.3 mmol/l and above. Particularly worth noting are the 24 out of 413 patients (7%) who had potassium levels of 6.5 mmol/l and above. The pattern of the levels of both the electrolytes was similar in the children as in the adults.

Table 12

Urine Protein of 456 patients with Acute Glomerulonephritis

Protein (mg/dl)	Children (n=291)	Adults (n=165)	Total (n=456)	%
0	31	15	46	10
30	81	26	107	23
100	93	54	147	32
300 and above	86	70	156	34

Urine protein was determined by dipstick, a semi quantitave method. 30% of the children and 42% of the adults had proteinuria of 300 mg/dl or above.

Table 13

Serum Albumin of 272 patients with Acute Glomerulonephritis

Serum Albumin g/dl	Children (n=173)	Adults (n=99)	Total (n=272)	%
Below 2	69	50	119	44
2 and above	104	49	153	56

Bromocresol green dye method was used for determination of serum albumin at Kenyatta National Hospital. The reference range is 2.6 to 5.2 g/dl and level below 2g/dl is a cardinal feature of nephrotic syndrome. 272 out of the 456 patients (60%) had serum albumin determined on admission. Table 13 shows that 119 of the 272 patients (44%) had serum albumin levels below 2g/dl. The 272 patient whose serum albumin was determined were selective in that they all had marked generalised oedema and albuminuria or admission. Table 14 shows the levels of urine albumin in patients who had serum albumin below 2g/dl, pointing out that 116 out of 119 (97%) had albuminuria of 300 mg/dl and above. This group of patients are considered to have presented with cardinal features of nephrotic syndrome along with features of acute glomerulonephritis on admission.

Table 14

Levels of Urine Proteins in 119 Patients with Acute Glomerulonephritis and Serum Albumin Levels below 2g/dl

Urine Albumin (mg/dl)	Children (n=69)	Adults (n=50)	Total (n=119)	%
0	-	-	-	-
30	-	-	-	-
±00	1	2	3	3
300	68	48	116	97

Table 15

Results of Urine Culture for Bacteria in 233 Patients with Acute Glomerulonephritis

No. of Colonies per ml urine	Bacteria	Children (n=144)	Adults (n=89)	Total (n=233)
10^5 and above	Escherichia Coli	10	1	11
	Klebsiella	10	1	11
	Proteus	-		
	Streptococcus Fecalis	1		1
	Total	21	2	23
Below 10^5	Escherichia Coli	10	1	11
	Klebsiella	6	1	7
	Proteus	3		3
	Streptococcus Fecalis			
		19	2	21
No Growth obtained		104	85	189

233 out of 456 patients (5%) who fulfilled the criteria for diagnosis of acute glomerulonephritis has their urine cultured for bacteria. There appeared to be no preselection of these patients. Indeed urinalysis and culture was requested for all patients with acute glomerulonephritis as a routine. As pointed out in the criteria for diagnosis of acute glomerulonephritis, in this study, none of the patients with signs and symptoms suggestive of urinary tract infection were included. However, as is shown in Table 15, 23 out of 233 patients (10%) had colonies of 10^5/ml of urine and above. Colonies of 10^5/ml and above are considered as significant bacteriuria at Kenyatta National Hospital. Escherichia Coli and Klebsiella were the predominant bacteria isolated. 21 out of 233 patients (10%) had colonies below 10^5/ml of urine. Again Escherichia Coli and Klebsiella were the predominant bacteria isolated in this latter group of patients.

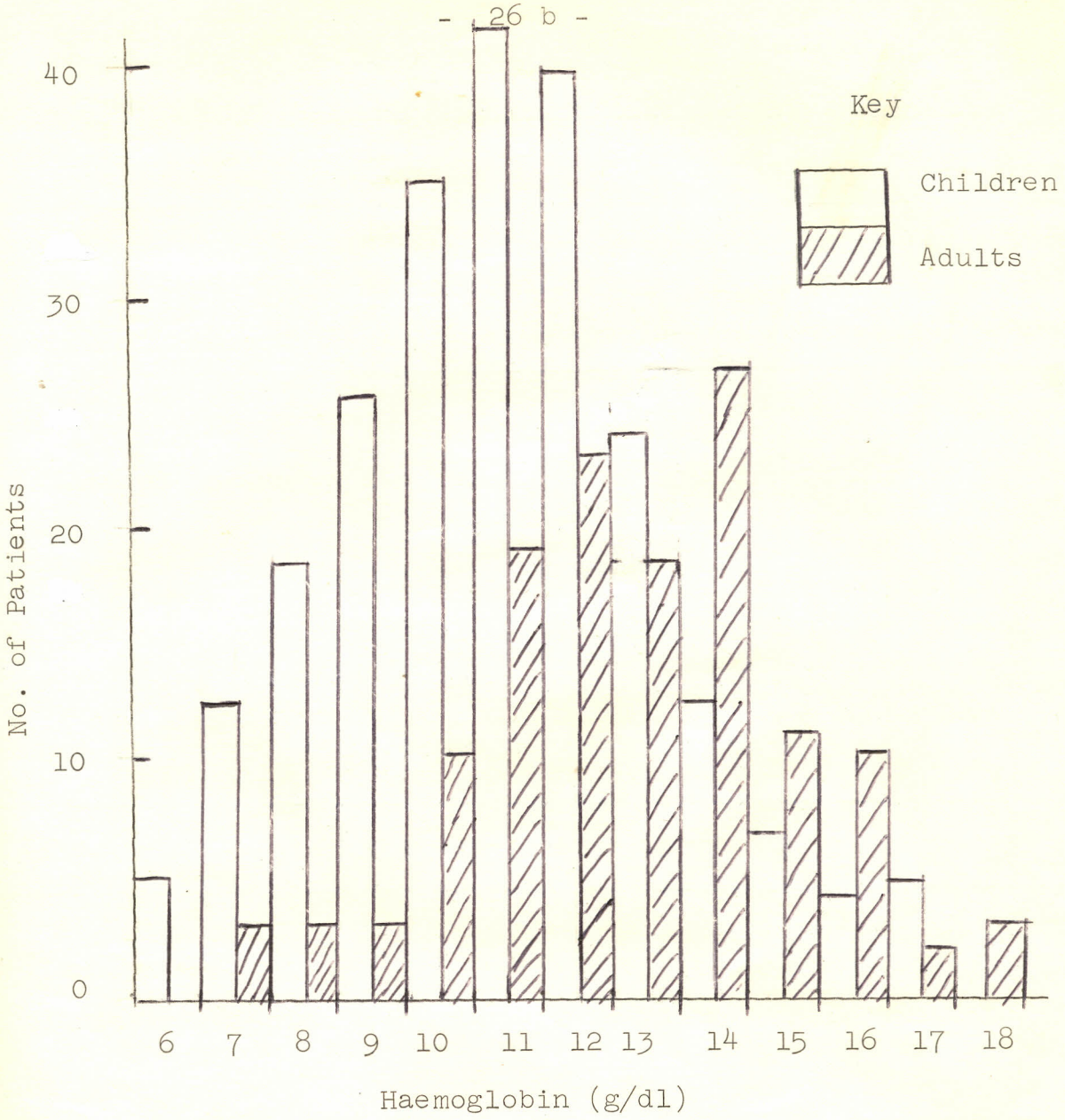

Fig 5: Haemoglobin Levels of 372 Patients with Acute Glomerulonephritis

Only 27% of the children and 8% of the adults had haemoglobin of 9 gm/dl. or below. Most of the adults had normochromic mormocytic anaemia whereas the children had hypochromic or macrocytic anaemia.

Table 16

Clinical Outcome of 259 Patients with Acute Glomerulonephritis

	Months after the onset of Acute Glomerulonephritis							Total	%
	0-11	12-23	24-35	36-47	48-59	60-71	72-83		
Children									
. Clinical Remission	106	11	3	4				124	75
. Deaths	6	1						7	4
. Nephrotic Syndrome	16	3	5	2	2	1	2	31	18
. Persisting features of Active Renal Disease	4					1	1	6	3
Total	132	15	4	6	2	2	3	164	100
Adults									
. Clinical Remission	44	12	2	1				59	62
. Deaths	8	2	1					11	12
. Nephrotic Syndrome	9	1		2				12	13
. Persisting features of Active Renal Disease	5	4		1			2	12	13
Total	68	17	5	3			2	95	10
Total Children and Adults	200	22	9	9	2	2	5	259	

259 out of the 456 patients (57%) had followup records ranging from 1 to 7 years. However only 59 out of the 259 patients (23%) were followed up for over 1 year. Table 16 shows the clinical outcome of the 259 patients over 7 years.

75% of the children and 62% of the adults followed up had clinical remission within 4 years from the onset of acute glomerulonephrits. Clinical remission was defined as the absence of clinical, urine and/or biochemical abnormalities in a followup review.

4% of the children and 12% of the adults who were followed up died. Most deaths occurred shortly after admission. 1 child and 7 adults died within a week of admission, ½ of these within the first 24 hours. 2 adults died in the second week. These early deaths were associated with acute pulmonary oedema, hypertension and/or hyperkalaemia.

18% of the children and 13% of the adults followed up developed features of nephrotic syndrome. Only 2 children and 1 adult had presented initially with nephrotic syndrome on admission.

3% of the children and 13% of the adults had persisting features of ongoing renal disease other than nephrotic syndrome. These features were: persisting hypertension, albuminuria, haematuria or various combinations of the same. 14 of these patients were lost to followup within the first year. 4 of them were still on followup as at the end of this study.

2 patients had a suspected second attack of acute glomerulonephritis. The first, a child, had the initial attack which remitted 3 months later. 7 months after the

onset of the initial attack this child had a suspected second attack of acute glomerulonephritis. This second attack remitted 13 months thereafter.

The second patient with a suspected second attack of acute glomerulonephritis was an adult who had this second attack 2 years after the onset of the first attack. Although he had had clinical remission 6 months after the first attack, he had persisting proteinuria, albuminuria but no oedema or uraemia after the second attack.

Table 17

49 Patients with Acute Glomerulonephritis: Renal Histology findings and their corelation with the clinical outcome of the Disease

		DPGN	RPGN	MPGN	FPGN	TOTAL
	Children	16	7	7	2	32
	Adults	9	4	2		15
	Total	25	11	9	2	47
Remission:	Children	3				3
	Adults					
	Total	3				3
Deaths:	Children	1	3			4
	Adults	3	3			6
	Total	4	6			10
Nephrotic Syndrome:	Children	10	1	3	1	15
	Adults	3				3
	Total	13	1	3	1	18
Other features:	Children	1				1
	Adults	2				2
	Total	3				3
Lost to followup:	Children	1	3	4	1	9
	Adults	1	1	2		4
	Total	2	4	6	1	13

DPGN Diffuse proliferative glomerulonephritis
RPGN Rapidly progressive glomerulonephritis
MPGN Membranoproliferative glomerulonephritis
FPGN Focal proliferative glomerulonephritis.

A total of 47 renal histology results were available (10% of the 456 patients) 7 of these were postmortem out of the 18 patients who died of acute glomerulonephritis. Consent for postmortem was not given in the 11 cases.

40 successful renal biopsies were performed in this study. These biopsies were performed in patients who had severe and persisting signs and symptoms of acute glomerulonephritis. Technical constraints relating to the availability of personnel and equipment to perform the biopsies curtailed the number of biopsies which would have otherwise been performed .

25 out of the 47 patients (53%) had diffuse proliferative glomerulonephritis characterised by hypercellularity of the glomeruli due to proliferation of endothelial and messangial cells. Histology specimens were obtained at 3 postmortems and 18 renal biopsies all performed within 7 months of onset of the disease.

11 out of the 47 patients (23%) had rapidly progressive glomerulonephritis. This is characterised by proliferative changes of glomeruli and epithelial cells lining the Bowman's capsule. The proliferative changes obliterate the glomeruli and the Bowmans space and are associated with fibrotic changes of these structures. 4 specimens were obtained at postmortem and 7 from renal biopsy, all performed within 4 months from the onset of the disease.

9 of the 47 patients (19%) had membranoproliferative glomerulonephritis, otherwise refered to as mesangio-capillary or lobular glomerulonephritis. It is characterised by lobulation of the glomerular tufts formed by proliferation of endothelial and messangial cells. There is Patchy thickening of capillary membrane and the lumen may be obliterated. All the 9 patients had renal biopsy done within a year of the onset of acute glomerulonephritis.

2 children had focal proliferative glomerulonephritis, a few glomeruli showing hypercellularity and the rest being normal. They had renal biopsy done 2 and 12 months after the onset of acute glomerulonephritis.

Table 17 corelates renal histology findings and clinical outcome of acute glomerulonephritis. The number involved are too small to enable statistically sound conclusions to be drawn. However, the low number of clinical remission cases is not unexpected. As was mentioned earlier, renal biopsies were done in patients who did not remit soon as expected. Most deaths were associated with rapidly progressive glomerulonephritis. It is likely that death occurred in the 4 patients with rapidly progressive glomerulonephritis lost to followup. It will be noticed that patients who developed nephrotic syndrome were drawn from all the 4 morphological types of glomerulonephritis. All these patients did not present with features of nephrotic syndrome on admission with acute glomerulonephritis. They developed features of nephrotic syndrome later in the course of their illness,

hence warranting a renal biopsy. It is emphasised that all these patients presented with typical clinical features of acute glomerulonephritis, satisfying the criteria for diagnosis in this study. There were neither clinical nor laboratory features that could distinguish the patients who later developed nephrotic syndrome with varying morphological types of glomerulonephritis either from one another, or from the rest of the patients with acute glomerulonephritis.

D I S C U S S I O N

6A CLASSIFICATION

Physicians have for a long time recognised various clinical forms of kidney diseases; but it is not until the fourth decade of the nineteenthcentury when attempts of clinicopathological classification of various forms of glomerulonephritis has been made.

In 1936 Longscope (29) recognised and described two types of glomerulonephritis in his 97 patients. Type A had acute onset of oedema, and haematuria with a recent streptococcal infection. These patients either healed or evolved into a quiescent nephritis. Type B had an insidous onset of oedema, haematuria and other symptoms suggesting renal disease. Most of these patients could not give a history of acute infection prior to the onset of their symptoms of renal disease. The patients had a worse prognosis than type A patients. They developed nephrotic syndrome, persisting hypertension and progression to renal insufficiency a few years after the onset of glomerulonephritis.

Ellis (18) in 1942 classified his 318 patients with glomerulonephritis into Type I and Type II. Type I patients, like Longscope Type A patients were the majority and had similar clinical features with the latter. So were Ellis Type II and Longscope type B patients. Ellis observed that his Type I patients followed 4 distinct courses: 82% completely recovered,

4% died in the acute stage, 4% died followed a rapidly progressive course, death ensuing in several months and 10% followed a slowly progressive course death occurring after several years. Ellis further observed that in his type II patients the disease was characterised by an insidous onset of severe oedema, hypoalbuminaemia, hypercholesterolaemia, variable haematuria, hypertension followed by progressive renal failure.

Various clinical and pathological classifications of glomerulonephritis have sprung up from Longscope and Ellis studies. At present, it is acknowledged that there is no single classification that will satisfy both the clinician and the pathologist; for classifications based primarily on aetiology, pathogenesis, morphology, clinical features or prognosis, or combinations thereof will obviously have shortcomings. However, most clinicians and pathologists alike would agree today that in the absence of systemic disease acute proliferative glomerulonephritis would correspond to the Type I of Ellis and Type A of Longscope. The ideal classification must take into consideration, patients with the same disease at different stages, or the same patient progressing through various stages of the disease, as determined by history, clinical and laboratory findings.

The advent of percutaneous renal biopsy techniques has added new light into the understanding of glomerulonephritis and other renal disease. However routine

renal biopsy is both unnecessary and unjustifiable for a great majority of patients with acute glomerulonephritis in view of their high recovery rate observed in the last 4 or 5 decades. Classification of glomerulonephritis entirely based on histology can therefore be properly applied only where histological standards are high and ethical standards low.

6B AETIOPATHOGENESIS

It is now agreed that the initiating event in the pathogenesis of acute glomerulonephritis is the deposition of pathogenic immune complexes in the glomeruli. This deposition leads to activation of the complement and coagulation systems leading to inflammatory and exudative glomerular reaction. The *immune complexes could be antibody-antigens or cross-*reacting antibodies. Circulating immune complexes have been demostrated in patients with acute glomerulonephritis. So are serum levels of C1, C4 and C3 depressed and granular deposition of C3 in the glomerular basement membrane and the messangium demonstrable. These findings implicate involvement of both classical and alternate pathways of the complement system (13, 28, 54).

Efforts have been made to identify the antigens that trigger off the formation of the immune complexes in acute glomerulonephritis. For a long time now, it has been known that acute glomerulonephritis often

follows throat or skin infections with certain strains of Lancefield Group A streptococcus refered to as nephritogenic strains. Several different antigenic components in these strains have been identified. There is indeed a very strong possibility that other infectious agents have antigens potentially capable of triggering the formation of the immune complexes resulting to sequelae of acute glomerulonephritis (13, 54). Such agents are being identified, and the list is growing, covering viruses bacteria protozoa, chlamydia and fungi. A few of these agents which may have a significant role in the aetiology of acute glomerulonephritis in Kenya are discussed.

Aetiological agents in the present study were inconsistently looked for. Only a few had throat swabs for bacterial cultures done; and some anti-streptolysin O titres (ASOT) estimated. The latter was more significant in the present study.

38% of the patients in the present study had ASOT determined by either of the two methods described earlier in the results. Whether the results obtained by both methods are considered singularly or seperately they both show that over 75% of the patients had ASOT of 200 international units/ml and above, thereby strongly implicating beta haemolytic streptococcus in the aetiology of acute glomerulonephritis in these patients. Further support to this contention is seen in the relative

proportions of patients who had high titre levels of 400/600 international units and above and the few patients who had a demonstrated rising ASOT. The titres in the present study are high in a significant proportion of the patients. This is despite the fact that some patients with post-pharyngeal acute glomerulonephrits may not exhibit a rising ASOT, especially if antibiotics have been administered in the early phase of the disease. Such was often the case in the present study. As well, it is known that pyoderma associated acute glomerulonephritis evokes a less vigorous ASOT response (56). Comparable high ASOT have been reported in the few studies on acute glomerulonephritis done in Africa (1, 20, 22).

Anti nicotinamide adenine dinucleotidase is an antibody vigorously elaborated after a streptococcal sore throat, often unaffected by antibiotic therapy. Streptococcal pyoderma evokes much less response of this antibody. However a vigorous response of two antibodies, anti deoxyribonuclease B and antihyaluronidase follows streptococcal pyoderma. Assay of these antibodies directed against the appropriate streptococcal cell wall antibodies is now recommended in recognition of recent streptococcal infections (56). None of these assays are done routinely at Kenyatta National Hospital.

Only 20% of the patients in the present study

had bacterial cultures for throat or skin done. It should be noted that only 23% of the patients gave history of throat infection and 16%, history of skin infection, majority of the latter being adults. 10 out of 73 patients with pyoderma related glomerulonephritis had scabies, a finding also reported in India (23) and Trinidad (39).

There was hardly any significant yield of streptococci in bacterial cultures done in the present study. Several explanations are possible. The proportion of patients who had bacterial cultures done in this study is low. There is a significant inhibition of culture growth by antibiotics, mainly penicillin which was often administered to patients before admission and before the taking of specimens. Normal flora and gram negative commensals were often grown.

In a recent prospective study of infections in malnourished children at Kenyatta National Hospital (55) the pattern of throat bacteria growth from these children was similar to that in the present study. The malnourished children, like patients with acute glomerulonephritis tended to have had antibiotics prior to throat swabs being taken.

Under such circumstances therefore, a low yield of streptococci from patients with acute glomerulonephritis would be expected. Such a low

yield has been reported in two studies on this disease in Kenya and in Uganda (22, 42). The Kenya study raised doubts on the role of beta haemolytic streptococcus in the aetiology of acute glomerulonephritis at Nyeri. The high levels of antistreptolysin titres in the present study coupled with the possible explanations on the low yield of streptococcus do infact strongly incriminate the streptococcus as an aetiological agent in majority of cases of acute glomerulonephritis at Kenyatta National Hospital. This could possibly be so in over 75% of all the cases admitted with the disease.

Nephritogenic strains of Lancefield Group A streptococcus have been catalogued according to their M and T proteins. The M protein is a cell wall antigen identifiable by immunoprecipitation technique. Some of the pyoderma related nephritogenic streptococcus are difficult to type on the basis of M protein but are typable on the basis of T protein agglutination. T protein is another cell wall antigen.

Wannamaker (56) has documented in details the M streptococcal serotypes associated with acute glomerulonephritis. Type 12 is the commonest and so far best confirmed serotype associated with pharyngitis and serotype 49 related to skin infections. Type 1, 3, 4 related to pharyngeal infections and type 2, 55 and 57 related to skin infections are less frequently

associated with acute glomerulonephritis.
A probable association with acute glomerulonephritis, still to be confirmed, exist between the following strains: types 6, 25, 49 related to phyaryngeal infections and type 31,52 and 56 related to skin infections. Type T-14 also related to skin infections has been associated with acute glomerulonephritis.

Out of 27 patients with post-pharyngitis acute glomerulonephritis whose throat swabs were taken for bacteria culture in the present study, 6 had heavy growth of staphylococcus aureus. So were all the 7 patients with post-pyoderma acute glomerulonephritis who had skin cultures for bacteria done.

Staphylococcus Aureus has been incriminated in the aetiology of acute glomerulonephritis. Spector and coworkers (53) described 3 patients with visceral staphylococcus aureus infection without endocarditis, who developed acute glomerulonephritis. One of the patients had diffuse proliferative glomerulonephritis while the other two had membranoproliferative glomerulonephritis with lgA, lgG and C3 deposits. Immonofluorescent staphylococcus aureus antigen deposits have been demonstrated in a similar patient by Yum and coworkers (59). Soto and coworkers (52) have, in

addition demonstrated high levels of antistaphylolysin antibodies in their patients with staphylococcus related acute glomerulonephritis. This antibody is directed against a cell wall product of staphylococcus antigen. These findings call for a more cautious view on the role of staphylococcus aureus in the aetiology of acute glomerulonephritis in the present study.

No patient in the present study had adequate evidence of malaria infection prior to the onset of acute glomerulonephritis. Kinuthia and coworkers (25) did not find malaria an important aetiological agent in nephritic nephrotic patients at Kenyatta National Hospital. Nevertheless, an association between malaria and acute glomerulonephritis has been made and probably may be significant in malaria endemic areas (8, 11).

Hepatitis B surface antigen was looked for in only 3 adults in the present study but not found. Recent work in Nigeria by Obineche and Awunor-Renner (40) incriminate hepatitis B as playing a significant role in the aetiology of acute glomerulonephritis. 41% of their patients with acute glomerulonephritis had hepatitis B surface antigen against 9.8% of the control. Their control figures correlate closely with the incidence of hepatitis B antigenaemia in the Tropics as has been found by many workers. Hepatitis B antigen deposits have been demonstrated in patients with acute glomerulonephritis (12).

6C SOME ASPECTS OF EPIDEMIOLOGY

The peak age of acute glomerulonephritis is between 3 and 7 years as found in the present study and by other workers particularly Hutt and White in Uganda (22) McCrory and Shibuya (32) and Sanjad and coworkers (47) in United States of America. This disease has been found to be rare in infancy; It is rare to isolate beta haemolytic streptococci from children under 3 years with exudative pharyngitis (9) whereas streptococcal impetigo is rare at this age (3). In the present study only 6% of the children studied were of 2 years and below, there being only 2 children of $1\frac{1}{2}$ year old and none less than one year old.

Acute glomerulonephritis is not uncommon in adults. In the present study, 19% of all patients studied were 21-30 years old and a further 8% of 31 years of age and above. The eldest two patients were 45 and 42 years. Cases of acute glomerulonephritis of 50 years and above have been described by Lee and co workers (27).

Although 30% of the females in the present study were adults of 16 years and above, none was expectant at the onset of acute glomerulonephritis. Acute glomerulonephritis is rare in pregnancy, even though cases have been reported from time to time (51).

For some undefined reasons, acute glomerulonephritis tends to affect males more than females both in children and adults. This has not only been found in the present study but also in studies by Burke and Ross (10) and others (32, 47). Male to female ratio in these studies ranges from 3:2 to 2:1.

All the cases of acute glomerulonephritis in the present study appeared sporadic with a fairly constant annual prevalence. Peak prevalence was in the cold season, similar to that found elsewhere in temperate and tropical countries. Pharyngitis, respiratory infections and in some cases pyoderma tend to be prevalent in cold seasons (47, 56).

Although familial outbreaks of acute glomerulonephritis following streptococcal pharyngitis do occur sporadically from time to time, there was no family history of such occurence from patients in the present study. Recently 22 families have been studied after sporadic appearance in each family an index case with acute poststreptococcal glomerulonephritis (46). A high attack rate of 37.8% in sibling contacts at risk was noted. Zimmerman and Wilson (60) in 1964/65 also demonstrated a substantially more susceptibility to acquisition and intrafamilial spread of beta haemolytic streptococcus in families with an index case of streptococcal infection. It is possible that a variation

in host responsiveness to a given antigenic challenge may be responsible for the observed familial spread of acute glomerulonephritis. It has been suggested that such a variation might be due to genetically determined differences in responsiveness based on immune response genes located with the histo-compatibility complex (48).

6D CLINICAL FEATURES

The latent period between the onset of either throat or skin infection and the onset of acute glomerulonephritis was given by 71% and 58% of the patients who gave a history of these respective infections in the present study. It should be noted that this group of patients formed only 38% of the 456 patients in this study. The latent period for post-pharyngeal acute glomerulonephritis was 5-14 days. For post pyoderma acute glomerulonephritis the latent period was a not well defined range of 5-30 days. Similar studies elsewhere reveal that the latent period for post-phyaryngeal acute glomerulo-nephritis averages 10 days and for post-pharyngeal acute glomerulonephritis, 18-21 days (47, 56).

Periorbital oedema is one of the earliest symptom of acute glomerulonephrits. It is more noticeable in the morning after waking. This is due to the absence of orthopnea which permits one to sleep flat and so accumulate retained fluid in

The subcutaneous tissue of the face. However generalised oedema was observed in the majority of patients in the present study and has been recorded as the more common form the presentation in other similar studies (1, 22, 47).

A proportion of patients present with evidence of macroscopic haematuria, 38% in the present study and a range of 1/3 to 2/3 reported in several other studies (1,10,22,47). Microscopic haematuria along with leucocyturia and casturia is always present in acute glomerulonephritis. These features are used as criteria for diagnosis of acute glomerulonephritis in this and many other studies and are included in the clinical definition of acute glomerulonephritis as mentioned earlier. However, cases of acute glomerulonephritis with minimal or no haematuria are being recognised in adults and children (21).

Several workers have noted that the incidence of hypertension in acute glomerulonephritis ranges between 50% and 80% (1, 10, 22, 47). 50% of the patients in this study had hypertension and ought to be looked with caution. Technical difficulties related to the accuracy and consistency of the equipment and method of recording blood pressure are bound to be significant in the present study especially in the recording of blood pressure of the smaller children.

10% of the hypertensive patients had symptoms suggestive of hypertension i.e. headaches, vomiting, epistaxis and convulsions. The few that had convulsions presented as hypertensive encephalopathy. Cases of acute glomerulonephritis presenting primarily as hypertensive encephalopathy are not uncommon (21). It should also be noted that acute glomerulonephritis has been found to be the leading cause of hypertension and hypertensive encephalopathy in childhood.

The incidence of oliguria is minimised in the present and many other studies by the fact that it often represents a symptom noticed by the patient or the parents of a child with acute glomerulonephritis. Accurate input output charts in the present study were hardly maintained but for a handful of patients mainly adults and older children. Nevertheless, adults whith acute glomerulonephritis who are oliguric on admission have been found to have a poorer prognosis than oliguric children (7).

6E LABORATORY INVESTIGATIONS

Blood urea was raised in 61% of the patients in the present study. Studies elsewhere record over 50% of patients with acute glomerulonephritis as having raised blood urea and associated with reduced glomerular filtration rate (9, 22, 47).

Majority of the patients in the present study had serum sodium and potassium done. 19% had low sodium levels attributable to a dilutional basis in patients with reduced glomerular filtration rate who have a free access to fluids (15).

Of interest in the present study is the level of serum potassium. 29% had high potassium levels on admission. Hyperkalaemia is a leading cause of death in acute glomerulonephritis and acute renal failure, due to its cardiotoxicity and the associated metabolic acidosis. This is particularly so when serum potassium levels are 6.5 mmol/l and above (5). It is noted that 6% of the patients in the present study had this dangerous high levels of potassium on admission. It is noted too that 18 out of 259 patients (7%) who were followed up in the present study died in the acute stage. These patients were all hyperkalaemic although causes other than hyperkalaemia per se could be attributed to their deaths. Mortality due to hyperkalaemia has been considerably reduced in the developed countries by availability

of intensive care and dialysis facilities in most centres. The present study has underscored the high frequency of this common features in acute glomerulonephritis which has to be borne in mind in the management of this disease in the local set up where facilities are inadequate. The incidence of hyperkalaemia in this study, however, corresponds to that found elsewhere (10, 15, 22, 47).

Anaemia was not a major feature of acute glomerulonephritis in the present study. Most of the patients with low haemoglobin levels had either hypochromic or macrocytic anaemia attributable to causes of anaemia other than acute glomerulonephritis.

6F ACUTE GLOMERULONEPHRITIS AND NEPHROTIC SYNDROME

90% of the patients in the present study had albuminuria of 30mg/dl. 34 of the patients had albuminuria of 300mg/dl and above. Among the latter were 119 patients, 69 being children, who presented as nephrotic syndrome on admission.

Many workers have found proteinuria of varying degrees in patients with acute glomerulonephritis. This proteinuria is often non selective, containing albumin, high molecular proteins and fibrin degradation products (7). Marked proteinuria occurring with massive fluid retention in an otherwise a typical presentation of acute glomerulonephritis is often encountered. Further relevant investigations bring out the clinical picture or nephrotic syndrome.

A number of patients with acute glomerulonephritis do present clinically as nephrotic syndrome. This mode of presentation of acute glomerulonephritis often refered to as nephritic-nephrosis has been documented by many workers (22, 26, 34, 58). Nephrotic syndrome occurring at the onset of acute glomerulonephritis in itself doesnot affect the clinical outcome of the latter. Nevertheless the nephrotic picture may persist, or nephrotic syndrome may develop during the course, or after clinical resolution of acute glomerulonephritis. Under these latter circumstances

the patients have unfavourable outlook gradually developing renal failure (58). In the present study, 17% of the 259 patients who had followup records had developed nephrotic syndrome. It is interesting to note that only two children and one adult presenting as nephrotic syndrome on admission persisted for upto 3 years with features of nephrotic syndrome after which they were lost to followup.

Kinuthia and co workers (25) studied the clinicopathological aspects of nephrotic syndrome at Kenyatta National Hospital recently. 51% of the children and 30% of the adults in that study had nephritic-nephrosis. Their age, sex, clinical presentation and laboratory findings closely corresponded to the patients with acute glomerulo-nephritis in the present study. It is quite probable that acute glomerulonephritis plays a significant if not a leading role in the aetiology of nephrotic syndrome in Kenya.

In the present study, most of the patients with nephritic-nephrosis who had renal histology done had diffuse proliferative glomerulonephritis -13 out of 18. 3 had membranoproliferative and one, focal proliferative glomerulonephritis. Again, a close correlation on the pattern of renal histology in patients with nephritic-nephrosis in the present study and the study refered to earlier (25) is noted.

9 patients who had membranoproliferative glomerulonephritis on histology presented initially with nephrotic syndrome. There were no distinct clinical or laboratory findings that could distinguish these group of nephritic-nephrotics from the other group of nephritic-nephrotics who had diffuse proliferative or focal glomerulonephritis on histology. However, the number of both groups was relatively small to draw concrete conclusions.

Studies have been done on clinicopathological aspects of membranoproliferative glomerulonephritis. (19). Whereas most patients present with nephritic-nephrotic picture as found in the present study, they fall into two distinct groups based on the pattern of their serum complement levels (28,33). The first group refered to as type I membranoproliferative glomerulonephritis have wide fluctuating, abnormal serum levels of C1q, C3, C4, C5 and properdin. Immuno-fluoresence studies show renal deposition of all these complements as well as IgG deposition. The pathogenesis of type I membranoproliferative is thought to be heterogenous and is found in patients who have malaria, sickle cell disease, hepatitis and other infections.

Patients with type II membranoproliferative glomerulonephritis are relatively fewer than those with type I. They have isolated depression of serum levels of C3 persisting for a long time, without

depression of serum levels of the other complements. As would be expected there are renal deposits of C3 only.

Evidence of association between the streptococcus and mebranoproliferative glomerulophritis is scanty (19). There may be, however, a significant association between malaria, hepatitis B and mebranoproliferative glomerulonephritis not demonstrated in the present study.

Two patients in the present study had focal proliferative glomerulonephritis, one of whom had presented with nephrotic syndrome. Such an association had been reported elsewhere (8, 25).

6G · ACUTE GLOMERULONEPHRITIS AND BACTERIURIA

Bacteria cultures were done on urine from 51% of the patients in the present study. These patients were not preselected. Routine urinalysis was done on all patients followed by urine culture provided the specimen was deemed suitable. The diagnosis of urinary tract infection in acute glomerulonephritis is a difficult one. The infection is usually asymptomatic and white cells as well as white cell cast, diagnostic of the infection are found in acute glomerulonephritis. 10% of the patients in the present study had significant bacterial growth (10^5 colonies/ml of urine and over) while 10% had insignificant growth. The interpretation of these findings is rendered difficult by the fact that the method of obtaining urine from the patients especially the younger children may have been far from perfect. Nevertheless, there was a close corelation on the frequency of bacteria isolated from the urine specimens from those patients with significant and insignificant growths. Eschericia coli and Klebsiella were far predominating. Proteus was also common. A prospective study on urinary tract infections in childhood at Kenyatta National Hospital done by Shah (50) in 1976 revealed a similar pattern of organism responsible for urinary tract infection. Similar pattern has also been recorded by Mwaura (36) and Wanyoike (57) in malnourished children at Kenyatta National Hospital.

Urinary tract infection may occur silmutaneously with acute glomerulonephritis either spontaneously or as a result of urinary tract manipulations performed in the course of management of acute glomerulonephritis. The incidence of urinary tract infection in the present study appears higher than that found in normal children of 3.5% (50). It is probably so because of the methodology rather than a true increased incidence of urinary tract infections in acute glomerulonephritis. It suffices to reemphasise the asymptomatic nature of presentation of urinary tract infections noted by all the workers refered to above. This aspect of the infections together with leucocyturia and casturia makes it particularly difficult to identify urinary tract infection in acute glomerulonephritis unless the infection is meticulously looked for.

6H CLINICAL COURSE

As mentioned earlier in the introduction, the course of acute glomerulonephritis is a subject of differing opinions. Literature is replete with studies on prognosis of acute glomerulonephritis with varying methodology and conclusions. However many workers would agree that in general, four clinical outcomes, similar to those described by Ellis prevail in acute glomerulonephritis.

- Gradual resolution of the abnormal clinical and laboratory findings.
- Death during the acute stages of the disease due to circulatory congestion, hypertension, encephalopathy, hyperkalaemia or severe pneumonia.
- Rapid progression of the disease with often irreversible decline in renal function often ending in death in a few weeks or months.
- Persistence of one or more abnormal clinical or laboratory finding accompanied by later development of progressive renal failure.

Followup in the present study being retrospective, had significant setbacks. There is a tendency in patients no to attend clinics after discharge if they feel well. Of the few that attend clinics, many are discharged once clinically better. 43% of the patients did not attend clinic for review. It is possible

though not absolute that most of them had improved and did not see the need of coming back to the hospital. This is probably evidenced by the fact that 75% of the patients who turned up for followup were discharged from the clinic on account of them being clinically well. The data on followup in this present study is the only one available in the experience with acute glomerulonephritis at Kenyatta National Hospital and has some few highlights concerning the clinical course of this disease.

(i) Clinical Remission

Many workers do agree that the majority of patients with acute glomerulonephritis recover completely. However, among the patients destined to recover, recovery takes place in unpredictable fashion often with haematuria, proteinuria and/or hypertension persisting in days or months (6, 14). This was the case in the present study where, although majority of the patients had remission in a year or less, some had symptoms and signs which persisted for upto 4 years before remission.

75% of the children and 62% of the adults in the present study had complete remission. It is probable that these figures are lower than they should be for two reasons. First, the present study was done in inpatients, who are hospitalised due to severity of their signs and symptoms. Patients with mild or moderate

clinical features of acute glomerulonephritis are managed at the outpatient departments. Secondly as has already been pointed out, patients who came back for followup tended to be those who had not felt well enough. Many workers have found complete remission in their patients, with acute glomerulonephritis ranging from 80% to 98% of the children. Although there is no agreement on the recovery rate in adults, a significantly lower proportion than that of children, about 66%, has been reported by many workers and has been reflected in the present study (6, 10, 14, 27, 32, 38).

Among many workers who have studied the clinical outcome of diffuse proliferative glomerulonephritis, Mota-Hernades and co workers (34) have recorded complete recovery in all their patients followup for upto 13 years. The present study had complete recovery of all the 3 children with proliferative glomerulonephritis who had renal biopsy done on account of persistence of signs and symptoms of acute glomerulonephritis.

Death rate in the present study was high in adults (12%), than in children (4%). Majority of the deaths occurred during the acute stage, within the first 4 days of the onset of the disease. These deaths were associated with pulmonary oedema, hypertension and/or hyperkalaemia. Of late, some

workers are reporting considerably less deaths in acute stage due to improved medical management of the acute stage and early dialysis when indicated (4, 7). Mortality rate at this stage is less than 5%. Considerable effort will have to be made to reduce the mortality rate at Kenyatta National Hospital and other hospitals in Kenya where immediate availability of laboratory facilities, intensive care and dialysis facilities is very far from satisfactory. In adults, particularly, fatal cases occurred with more severe manifestations of acute glomerulonephritis, often with atypical presenting features delaying the making of the correct diagnosis. Several workers have noted this unfavourable outcome of acute glomerulonephritis in adults in acute stage (27, 38).

The rapidly progressive course of acute glomerulonephritis lead to decline in renal function which is often followed by death in a few weeks or months. This course is characterised by typical morphological features of rapidly progressive glomerulonephritis already described. Renal histology is necessary to recognise this entity from the rest of the morphological forms of glomerulonephritis in which the disease may run in a florid course or even end up in death following complications of acute glomerulonephritis. In the present study, it is not possible to distinguish deaths which occurred due to complications of acute glomerulonephritis from those associated with rapidly

progressive glomerulonephritis because histology was done in very few cases. Nevertheless, two important features worth noting in the 11 patients who had rapidly progressive glomerulonephritis by histology. First, 6 of them died at the Hospital. Of all patients who had histology done, the majority of deaths occurred in this morphological entity. It is likely that the 4 deaths in patients who had diffuse proliferative glomerulonephritis were due to complications of acute glomerulonephritis. Second, although the number of adults with rapidly progressive glomerulonephritis was half the number of children, all adults except one (who was lost to follow up) died at the Hospital, supporting the contention of the poorer prognosis of adults with rapidly progressive glomerulonephritis than children (6). It should be noted that as high mortality as 100% has been recorded in patients with rapidly progressive glomerulonephritis (34).

(ii) Persistence of features Indicative of Ongoing Renal Disease

The persistence of features indicative of renal disease after acute glomerulonephritis has been an issue of controversy when looking into the clinical outcome of this disease. Perlman and co workers (43) having followed the Minnesota epidemic for 10 years concluded that majority of patients with acute

glomerulonephritis had complete recovery. Stetson and co workers (55) came to a similar conclusion in the Bainbridge epidemic.

On the other hand, evidence of chronic renal disease after acute glomerulonephritis is increasing in both epidemic and sporadic cases although the tendency has been to study clinical outcome of acute glomerulonephritis after an epidemic. In the present study, 21% of the children and 26% of the adults who were followed up after discharge from the hospital had persistence of one or more abnormal clinical or laboratory features of renal disease after the initial attack of acute glomerulonephritis. While most of these patients had features of nephrotic syndrome, discussed earlier, the rest, 3% of the children and 13% of the adults had features suggestive of ongoing renal disease of ill defined nature. Only 3 of this latter, group of patients had renal biopsy done, all within one year of onset of acute glomerulonephritis; they all had diffuse proliferative glomerulonephritis. Further insight into this group of patients is lacking as majority of the patients were lost to followup. It can be nevertheless concluded that from the present study, most children who had evidence of ongoing renal disease had nephrotic syndrome. In contrast, adults had a not clearly defined renal disease.

Observations on interelationships of acute glomerulonephritis and nephrotic syndrome has been discussed earlier. The discussion hereafter will confine on persistence of features of renal disease, other than nephrotic syndrome in the clinical outcome of acute glomerulonephritis. Baldwin and co workers (67) assert that over 50% of patients with acute glomerulonephritis do show evidence of renal disease at a later date if followed long enough. In one study, as high as 40% of hospitalised children with acute glomerulonephritis had clinical laboratory and histologic evidence of ongoing renal disease 2 to 16 years after the onset of acute glomerulonephritis (49).

Rodriguez-Iturbe and co workers (45) have demonstrated histologic and immunologic damage of kidneys of patients 5-6 years after the onset of acute glomerulonephritis in Venezuela. These patients were clinically asymptomatic and had no biochemical abnormalities. Persistent features of renal disease after acute glomerulonephritis has been reported in smaller population by other workers (17, 39, 58) who have noted an absence of persistent signs of renal disease in patients with morphologic type of diffuse proliferative glomerulonephritis other than nephrotic syndrome. The numbers of their

patients is however small and the period of followup short. In the present study, 3 of the 25 patients with diffuse proliferative glomerulonephritis developed persistent features of renal disease.

Literature on the incidence of end stage renal failure in patients with acute poststreptococcal glomerulonephritis is very scanty except by Schacht, and co workers (49) who have shown that it does occur.

Conclusions on the significance of persistence of renal disease after acute glomerulonephritis are difficult to draw from the present or other studies mentioned above. First hospitalised patients may show higher incidence of persistent renal disease. Indeed, it has been found that severe hypertension, high blood urea and massive oedema are inversely proportional to complete recovery. Needless to mention, patients with these symptoms are often hospitalised. Second, there is a wide variation of parameters that are used to detect renal disease. Interpretation of results from these parameters may be subtle. Absence of abnormal clinical and biochemical features in face of histologic and immunologic evidence of renal disease has already been mentioned (45).

2 patients in the present study had a suspected second attack of acute glomerulonephritis, a rare event known to occur. Type specific and long lasting immunity following streptococcal infection is conferred (47) probably accounting for rarity of the second attack and for decreasing incidence of the disease in adults. Earle and Seegal (16) do emphasise that exacerbations are preexisting status of renal function after the exacerbation.

CONCLUSIONS AND RECOMMENDATIONS

The present study has incriminated streto-coccal infections as playing a significant role in the aetiology of acute glomerulonephritis at Kenyatta National Hospital, based on antistreptolysin O titres. The yield of streptococcus from the patients was however hardly significant in this study with only less than a quarter of the patients / a definite /having history of throat or skin infection prior to acute glomerulonephritis. Majority of the pyoderma associated glomerulonephritis were adults.

The peak age, incidence, seasonal occurence and clinical manifestation, closely concurred with classical description of the disease. However, large proportions of the patients have hyperkalaemia to dangerously high levels, whereas a number of patients with acute glomerulo-nephritis present with nephrotic syndrome initially.

Clinical outcome of this disease as reflected in the present study has some differences from the outcome described in most of the literature. A high death rate in adults as well as development of nephrotic syndrome after the onset of acute glomerulo-nephritis is noted.

Arising from the present study are several areas that need further extensive research in connection with acute glomerulonephritis in Kenya:-

. Epidemiology of nephritogenic streptococcus in the Kenya community.

. Systematic search of aetiological agents in acute glomerulonephritis with a view to establish the role of streptococcus vis-a-vis staphylococcus, hepatitis B, and other agents in cases seen in Kenya.

. Evaluation of managment of acute glomerulonephritis, particularly identifying causes of the high death rate recorded especially in adults.

. Attempts to unfold the true picture of the long term prognosis of acute glomerulonephritis in Kenya. This will require a long term prospective study of patients with this disease, with a painstaking effort to limit the proportion of patients lost to followup. Such a study would have to be collaborated with extensive laboratory research into the disease.

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