ACUTE POSTSTREPTOCOCCAL GLOMERULONEPHRITIS

EPIDEMIOLOGY, CLINICAL PICTURE, INVESTIGATIONS COMPLICATIONS TREATMENT AND PROGNOSIS

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I am also indebted to Dr. TAMES LEONARD for discussing the project with me.

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Acute poststreptococcal glomerulonephritis is one of the commonest renal diseases in childhood, affecting predominantly the younger age groups following mostly group A beta haemolytic Streptococcal infection of upper respiratory tract or skin and rarely hepatitis B virus infection (M.W. Hassan 1963 and Feint 1971). From November 1978 to October 1979 420 children were referred to the pediatric referred outpatient; 10% of these children were proved to have acute poststreptococcal glomerulonephritis and were included in this study.

In 1641 Daniel Sennart remarked the association of scarlatina and the subsequent appearance of dropey; however it was not until two centuries later that this association was re-emphasized by Richard Bright in 1827. He thought that scarlatina was an actual cause of renal disease.

"...Scarlatina has apparently laid the foundation for the future mischief...." Bright and his collaborators proposed that cardiac hypertrophy was secondary and
proportional to gradual shrinkage in kidney size; that cerebral manifestations appeared late in the course of the disease, and that an increase in blood urea resulted from an inability to excrete urea into urine. Bright's intense interest in the mechanism of renal disease, aroused the interest of physicians of his time. Several investigators endeavoured to produce renal disease in animals, hoping by such experiment to gain knowledge of human disease.

The only significant results of these efforts however was the production of massive persistent proteinuria by bilateral ligation of renal veins - an entity although important quite unlike the process which has come to be known as Bright's disease.

After these initial investigations, interest again declined until the turn of the century when the phenomenon of hypersensitivity became prominent in minds of clinicians and investigators alike. The association of acute nephritis with scarlet fever was now well-established and in keen observation of Schick, the latent period between the onset of infection and the development of nephritis was noticed and emphasized. It was found to
vary in most patients in whom nephritis followed infections. It has also been shown that the blood and urine of patients with acute nephritis were sterile (Longscope 1928).

Kellet & Thomason observed 5 patients with significant suppression of complement activity in every case of acute nephropathies examined among 38 patients with nephropathies. They emphasized the relatively short duration of low complement titers in the early phase of acute nephritis and found suppression of complement activity might be a useful tool in the differentiation of the case of acute nephritis from an exacerbation of chronic nephritis.

In 1951 Lange reported low titers of serum complement in 5 children with acute nephritis, which did not differ significantly from similar values found in 8 adults with the same disease. In two children the level of serum complement returned to normal one week after the subsidence of clinical and laboratory signs of the nephritis activity.
In 1960 Lange demonstrated that of 291 patients of acute nephritis, all but one had markedly subnormal serum complement titers and that return of the titer to normal was associated with the disappearance of all clinical signs of nephritis.

There is much evidence that the disorder resembles the experimental model of acute serum sickness, in which the antigen is the streptococcus or part of it. As in experimental model, there is a latent period after exposure to the antigen. The disease tends to be explosive and it has a tendency to heal.

The relation between cross reactivity between streptococci and glomerular basement membrane is not fully agreed upon. Not all Group A beta hemolytic streptococci are followed by nephritis. This fact resulted in classification of nephritogenic strains, infection with which is followed by acute nephritis in a considerably higher proportion of cases than infection with non-nephritogenic strains. Type 12 is the classic serotype associated with acute glomerulonephritis after pharyngitis. Other types include type 1, 2, 4, 18, 25, 18, 49, 57 & 60. Types 49 & 57 were noticed to be
Comparison of pharyngitis associated and Pyoderma associated acute nephritis in U.S.A.
(Wannamaker 1970)

<table>
<thead>
<tr>
<th>Clinical Features</th>
<th>Pharyngitis-Associated</th>
<th>Pyoderma-Associated</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Clinical &amp; Pathological</td>
<td>No difference</td>
<td>No difference</td>
</tr>
<tr>
<td>(2) Familial occurrence</td>
<td>Common</td>
<td>Common</td>
</tr>
<tr>
<td>(3) Prognosis</td>
<td>Generally favourable</td>
<td>generally favourable</td>
</tr>
<tr>
<td>(4) Recurrences</td>
<td>Rare</td>
<td>Rare</td>
</tr>
<tr>
<td>(5) Season</td>
<td>Winter &amp; Spring</td>
<td>Late Summer &amp; Early fall</td>
</tr>
<tr>
<td>(6) Geographic distribution</td>
<td>North &amp; South</td>
<td>Predominantly South</td>
</tr>
<tr>
<td>(7) Age</td>
<td>Early School Age</td>
<td>Preschool</td>
</tr>
<tr>
<td>(8) Latent Period</td>
<td>10 days</td>
<td>3 weeks</td>
</tr>
<tr>
<td>(9) Attack rate</td>
<td>10 - 15%</td>
<td>10 - 15%</td>
</tr>
<tr>
<td>(10) Serologic Types</td>
<td>Limited Types</td>
<td>Also limited, But different types</td>
</tr>
<tr>
<td>(11) Streptococcal Antibody response</td>
<td>Generally good</td>
<td>Variable, depending on antigen</td>
</tr>
</tbody>
</table>
associated with epidemics of glomerulonephritis
(Fish 1970).
Recent improvement in typing and comparison of N-precipitation
types with T agglutination types have indicated further
differences both in nephritis associated with pyoderma and
that associated with pharyngitis. Detailed of these
differences is given in a review article by Wannamaker in
1970. (Table No. 1).

Nephritis after pyoderma seems to occur in younger
children than adults and there appear no differences between
the clinical and pathological manifestations of acute
glomerulonephritis after skin infection and that after upper
respiratory tract infections. Both have similar course and
generally favourable long term prognosis (Wannamaker 1970).

Although the antistreptolysin O titer (A.S.O.) in the
serum of patients have been used to indicate infection with
beta haemolytic streptococci, it is now generally agreed that
the titer of antibody to streptococcal nicotinamide adenine
dinucleotidase (N.A.D.-ase) is a better indication of previous
streptococcal infection of the throat and titer of anti-
deoxyribonuclease B (DNA-ase B) in patients with pyoderma
(Wannamaker 1970).
Acute poststreptococcal glomerulonephritis can occur sporadically or in epidemics and second attacks although rare can occur (Shane Roy 1969).

The glomerular lesion occurs from exogenous antigens that cross react with renal glomerular basement membrane. Sensitization to streptococcal wall membrane which acts as antigen, cross react with glomerular basement membrane producing antibody that complexes both with streptococcal wall antigen and with host's own basement membrane antigen. This process occurs through activation of the complement pathway by the classical way: C1 acts on C2 & C4 components resulting in the production of a C2a, C4 complex known as C3 convertase which acts on C3 splitting it into small and large subunits C3a, C3b. C3b in association with its activating enzyme forms another enzyme, C5 convertase and this leads on to the last stage, C3 can also be activated through the alternate pathway which misses the C1, C4 & C2 components and starts at the step of C3. (Weir 1976).

In general there is agreement that when acute poststreptococcal Glomerulonephritis does heal, it may take many years, although classically particularly in children it is a short self-limited disease and the prognosis is worse in adults (Shane Roy 1975).
MATERIALS AND METHOD

PATIENT'S SELECTION AND INITIAL EVALUATION

Patients selected by referral to the Paediatric outpatient clinic in Khartoum Civil Hospital and Soba University Hospital were seen. Inclusion of the child in the study group was predicted upon the following criteria.

Acute onset of oedema and or hypertension and a recent history of infection suggestive of Streptococcal endocarditis with a latent period before the onset of symptoms of renal disease.

The study was carried out from November, 1978 to October, 1979.

CLINICAL APPRAISAL OF HOSPITAL COURSE

The severity of each patient's illness was estimated by the degree of oedema, daily blood pressure, daily urinary output and blood urea.

CLINICAL AND BIOCHEMICAL ANALYSIS

Blood pressure was determined by a sphygmomanometer using the correct cuff size that comfortably covers the lower two thirds of the upper arm so that its bladder was wide enough and long enough
to encircle the arm's girth. Cuff size of 9 cm. for 3 years to 8 years old children and 12.5 cm. for older children were used.

Patients were labelled hypertensive if a blood pressure of $140 \text{ mm Hg or more was recorded.}$

**URINE ANALYSIS:**

A mid-stream urine was collected in a clean container and examined within an hour.

**REACTION:**

Determined by litmus paper, red colour indicating acidity and blue colour alkaline.

**PROTEINURIA:**

Determined by albustix. The strip was completely immersed in a fresh centrifuged sample of urine for no more than one second. Colour of strip was compared with indicator colour chart within ten seconds. The results are reported in aseniquantitative terms from 0 to 4*

+1 = 30 mg./100 ml. of urine

+2 = 100 mg./100 ml. of urine
+3 = 300 mg./100 ml. of urine
+4 = 1000 mg./100 ml. of urine

(Normal value 300 mg./24 hours. Lieberman 1975)

URINE SEDIMENT:

Urine was centrifuged; a drop of the deposit was placed on the centre of a slide and covered with a cover glass. The preparation was then examined with low and high objectives.

RED BLOOD CELLS:

Usually of normal size and may according to the density of urine appear either swollen or shrunken and crenated. They are recognised by their shape and biconcavity and particularly by their colour. More than three red cells per higher field are regarded abnormal (Normal Value less than 3 red cells per high power field. Liebemann 1975).

LEUCOCYTES:

Recognised by their shape, the lobed form of their nuclei and their refractile granular appearance. (Normal value: less than 10 W.B.C./mm² in high power field. Lieberman 1975).

GRANULAR CASTS:

Recognised by their shape with rounded ends. They
are composed of homogenous material which have a finely stippled or more coarsely granular texture. They are colourless with sharp outline and may at a time look dense enough to look rather black.

**Hematology:**

Haemoglobin value and total white blood count were determined by Coulter counters.

Erythrocyte Sedimentation rate (E.S.R.) was determined by Westergren Method.

**Bacteriological Studies:**

Swab cultures from tonsillar, pharynx or skin lesion were obtained from each suspect of acute nephritic patient on the first day of admission to hospital. The cultures were seeded by both poor and streak techniques on sheep blood agar for ready detection of beta haemolysis after 24 hours incubation at 37°C. Identification was by the type of colony produced and by sensitivity tests using bacitracin which inhibits other types of haemolytic streptococci. No typing was done.

**Sodium & Potassium:**

were determined by the use of flame emission Photometry. The solution (Plasma) is sprayed as a fine
mist of droplets into luminous flame, which becomes coloured by the characteristic emission of the metal. Light of wavelength corresponding to the element being analyzed was selected by a light filter and allowed to fall on a photocell. The signal from the photocell is a measure of the concentration of the element.

**Blood Urea:**

was determined by 0.1 mL of plasma mixed with 10 mL of distilled water by a spectrophotometer.

**Plasma Protein:**

Determined using 0.2 mL of plasma by spectrophotometer.

**Antistreptolysin O Titer:**

Was determined using 0.1 mL of plasma mixed with 4.9 mL of A.S.O. buffer in a series of 6 tubes with increasing concentrations from 1/50 to 1/800; after refrigeration for two hours, 0.5 mL of 8% cells in buffer solution was added in each tube and the test tube which shows no haemolysis is the titer.

**Complement C3 Level:**

Determined by 0.1 mL of plasma in a plastic plate sprayed with agar; then sheep antihuman C3 was added and the agglutination produced was read from a chart.
24 HOURS URINARY PROTEIN:

Urine was collected in a clean flask from 8 a.m. to 8 a.m. on the second day. Protein was then determined using a spectrophotometry.
OBJECTIVES

The objectives of this study are the following:

1. Epidemiological survey, including age group, sex, seasonal variation and social class.

2. Relations to streptococcal infection.

3. Immunologic disturbance.


5. Treatment.

6. Complications

7. Prognosis.
Table No.4

Showing Socio-economic status of the study Group

<table>
<thead>
<tr>
<th>Fathers Occupation</th>
<th>Labourer</th>
<th>Farmer</th>
<th>Professional</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of patients</td>
<td>35</td>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td>Percentage of Total</td>
<td>83.3%</td>
<td>14.2%</td>
<td>2.3%</td>
</tr>
<tr>
<td>Age in Years</td>
<td>13</td>
<td>9</td>
<td>4</td>
</tr>
<tr>
<td>--------------</td>
<td>----</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Month</td>
<td>12</td>
<td>7</td>
<td>12</td>
</tr>
<tr>
<td>Latent period in days</td>
<td>5</td>
<td>14</td>
<td>19</td>
</tr>
<tr>
<td>A.S.O. titer Todd Units/ml</td>
<td>320</td>
<td>189</td>
<td>370</td>
</tr>
</tbody>
</table>
RESULTS

The study group was composed of 12 children with an age group of 5 years to 14 years with a mean age of 8.5 years. Males were 28 patients and females 14 patients with a male to female ratio of 2 : 1 (See Table 2).

The maximum incidence of the disease occurred from November to April i.e. in Winter in 24 patients constituting 57.1% of the total number. 36 patients (85.8%) presented with a history of upper respiratory tract infection with a mean of 10 days prior to the appearance of the renal problems & 6 patients (14.2%) with a history of pyoderma with a mean of 14 days before the renal disease. (Table 3).

97.6% of patients were of low social class, living in relatively crowded areas with poor hygienic facilities and very low monthly income (Table 4).

CLINICAL FEATURES:

Clinical features listed in Table No.4 shows that periorbital oedema, hematuria & oliguria were
### Table No. 2

**Showing different Age Groups**

<table>
<thead>
<tr>
<th>Age in Years</th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>4</td>
<td>2</td>
<td>-</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>5½</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>6</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>7½</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>8</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>8½</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>9</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>10</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>12</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>13</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>14</td>
<td>1</td>
<td>-</td>
</tr>
</tbody>
</table>

**Chart:**

- **X-axis:** Age in Years
- **Y-axis:** No. of Patients
- **Legend:**
  - Male
  - Female
<table>
<thead>
<tr>
<th>CLINICAL PICTURE</th>
<th>NO OF PATIENTS</th>
<th>% OF TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Periorbital Oedema</td>
<td>42</td>
<td>100%</td>
</tr>
<tr>
<td>Oedema of the lower limbs</td>
<td>21</td>
<td>50%</td>
</tr>
<tr>
<td>Low grade fever</td>
<td>20</td>
<td>47.5%</td>
</tr>
<tr>
<td>Nausea</td>
<td>12</td>
<td>28.3%</td>
</tr>
<tr>
<td>Enuresis</td>
<td>12</td>
<td>28.3%</td>
</tr>
<tr>
<td>Abdominal pain</td>
<td>17</td>
<td>40.2%</td>
</tr>
<tr>
<td>Abdominal distension</td>
<td>6</td>
<td>14.2%</td>
</tr>
<tr>
<td>Breathlessness</td>
<td>8</td>
<td>19%</td>
</tr>
<tr>
<td>Convulsions</td>
<td>1</td>
<td>2.3%</td>
</tr>
<tr>
<td>Haematuria</td>
<td>42</td>
<td>100%</td>
</tr>
<tr>
<td>Oliguria</td>
<td>42</td>
<td>100%</td>
</tr>
<tr>
<td>Blood pressure 130/90 mm Hg or more</td>
<td>35</td>
<td>85.8%</td>
</tr>
</tbody>
</table>
noticed in 42 patients (100%) while oedema of the lower limbs was evident on clinical examination in 21 patients only (50%), low grade fever of 38°C in 20 patients (47.6%) and headache in 21 patients (50%). Gastrointestinal symptoms were common: nausea & vomiting in 12 patients (28.5%), abdominal pain in 17 patients (40.2%), abdominal distension in 6 patients (14.2%) while emesis was observed in only 28.5% of patients.

Hypertension of 120 mm Hg or more was noticed in 85.6% of patients and 14.4% of patients were normotensive.

Convulsions were noted in only one patient. (Table 5).

**Biochemical Analysis:**

**Urine Analysis:**

On day of admission proteinuria of 100 to 300 mg/100 ml of urine was found in 39 patients (91.9%), of 1000 mg/100 ml of urine in only 3 patients (7.1%). Microscopic haematuria was found in all patients the values were from 20 to 50 R.B.C. per H.P.F. Granular casts were found in 30 patients (71.4%); pus cells were below 10 W.B.C. in H.P.F. in 42 patients (100%).

**Blood Urea:**

As shown by Table No.5, it was moderately raised in 34 patients (76.2%) and more than 80 mg/100 ml of
**Urine Output in the first 24 Hours**

<table>
<thead>
<tr>
<th>Urine Volume in mL</th>
<th>No of patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>200 - 250</td>
<td>24</td>
</tr>
<tr>
<td>250 - 300</td>
<td>15</td>
</tr>
<tr>
<td>300 - 350</td>
<td>1</td>
</tr>
<tr>
<td>350 - 400</td>
<td>2</td>
</tr>
</tbody>
</table>
blood in 5 patients (Table No.6).

"Normal blood urea 10-20 mg/dl Nelson."

**POTASSIUM:**

The mean potassium level in the study group is 4.3 mEq/L. Hyperkalaemia was not recorded in any patient (More than 5.5 mEq/L).

"Normal value 3.5 - 4.7 mEq/L - Nelson."

**SODIUM:**

The level varied from 135 mEq/L to 140 mEq/L in 37 patients (83.1%). Hypernatraemia (more than 145 mEq/L) was observed in only two patients (4.4%).

"Normal value 135 - 145 mEq/L Nelson."

**PLASMA PROTHROMIN:**

Varied from 5.6 gm/dl to 8 gm/dl in the following way:

from 5.6 gm/dl to 6 gm/dl in 3 patients constituting 19% of total; and from 6 gm/dl to 8 gm/dl in 79% of patients. Albumin fraction was always above 2 gm/dl.

The number of patients with albumin level of 2 to 3 gm/dl were 5 (11.9%) and between 3 to 4.5 gm/dl in 34 patients (79%).

"Normal value 6.2 to 8.1 gm/dl with albumin fraction of 4 - 5.0 gm/dl Nelson."
<table>
<thead>
<tr>
<th>Haemoglobin level on admission to hospital</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of Patients</td>
</tr>
<tr>
<td>-----------------</td>
</tr>
<tr>
<td>7.2 gm - 8 gm/dl</td>
</tr>
<tr>
<td>more than 8 gm/dl</td>
</tr>
</tbody>
</table>
Table No. 3 (C)

A.S.O. Titer in Todd Units per ml

<table>
<thead>
<tr>
<th>Value</th>
<th>No of patients</th>
<th>% of total</th>
</tr>
</thead>
<tbody>
<tr>
<td>120-250</td>
<td>11</td>
<td>26.1%</td>
</tr>
<tr>
<td>250-400</td>
<td>29</td>
<td>62.2%</td>
</tr>
<tr>
<td>More than 800</td>
<td>2</td>
<td>4.7%</td>
</tr>
</tbody>
</table>
### 24 Hours Urinary Proteins

<table>
<thead>
<tr>
<th>Value</th>
<th>No of patients</th>
<th>% of total</th>
</tr>
</thead>
<tbody>
<tr>
<td>130 mg - 0.5 gm.</td>
<td>40</td>
<td>95.3%</td>
</tr>
<tr>
<td>0.5 gm - 1 gm.</td>
<td>2</td>
<td>4.7%</td>
</tr>
</tbody>
</table>

"Normal value less than 300 mg/day Nelson"
HAEMATOLOGICAL DATA:

Moderate hypochromic anaemia (7.2 - 8 gm/dl)
was noted in 38% of patients only.

"Normal value 11 - 16 gm/dl Nelson."

ERYTHROCYTE SEDIMENTATION RATE (E.S.R.)

E.S.R. was high in all patients on the day of
admission. It varied from 25 mm/hour to 125 mm/hour.
The mean value was 66.4 mm/hour.

"Normal value 3 - 13 mm/hour Nelson."

WHITE BLOOD COUNT:

was within normal limits in 39 patients (87.2%)
and between 11 thousand/cu. mm. and 12 thousand/cu. mm. in 3
patients (7.2%).

"Normal value 5 - 10,000/cu. mm. Nelson."

24 HOURS URINARY PROTEINS:

was less than one gm in all patients, however the
majority of patients (95.3%) had values less than
0.5 gm/24 hours.

ANTISTREPTOLOGIN O TITER:

Values varied from 125 to 800 Todd units/ml.

at the onset of the disease. The value was estimated
### Table No.6

**Blood Urea level on admission**

<table>
<thead>
<tr>
<th>Blood Urea in mg/dl of blood</th>
<th>No of patients</th>
<th>% of total</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 - 40</td>
<td>19</td>
<td>45.5%</td>
</tr>
<tr>
<td>40 - 60</td>
<td>15</td>
<td>35.7%</td>
</tr>
<tr>
<td>60 - 80</td>
<td>1</td>
<td>2.3%</td>
</tr>
<tr>
<td>80 - 100</td>
<td>4</td>
<td>9.5%</td>
</tr>
<tr>
<td>100-120</td>
<td>1</td>
<td>2.3%</td>
</tr>
<tr>
<td>120-140</td>
<td>1</td>
<td>2.3%</td>
</tr>
<tr>
<td>140-160</td>
<td></td>
<td></td>
</tr>
<tr>
<td>160-180</td>
<td></td>
<td></td>
</tr>
<tr>
<td>180-200</td>
<td></td>
<td></td>
</tr>
<tr>
<td>200-220</td>
<td>1</td>
<td>2.3%</td>
</tr>
</tbody>
</table>
Table No. 3 (b)

Showing isolation of beta haemolytic Streptococci

<table>
<thead>
<tr>
<th>Site</th>
<th>No of patients</th>
<th>Percentage of total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Throat</td>
<td>10</td>
<td>23.6%</td>
</tr>
<tr>
<td>Skin</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
only at admission due to the shortage of reagents.
39 patients had values above 250 Todd units/ml (92.8%)
while two patients had values of 123 Todd units/ml.
and two had 800 Todd units/ml.

"Normal value 12 - 100 Todd units/ml. Nelson"

COMPLEMENT C3 LEVEL:
Because of the non availability of the reagents
the level could be determined in only four patients.
AU had a value of 99 mg/ml.
Normal 132 mg/ml

BACTERIOLOGICAL STUDIES:
Group A beta haemolytic streptococci was isolated
from the throat of 10 patients (23.6%); no positive
culture was obtained from skin lesions.

URINE OUTPUT IN THE FIRST 24 HOURS:
Table No. 8 shows that all patients were oliguric
(less than 400 ml of Urine/24 hours) on the day of
admission.

Normal Urine Volume:
Child  500 - 1000 ml/24 hours
Adolescent  500 - 1500 ml/24 hours = Nelson
BED REST:

36 Children with high blood pressure were confined to bed till hypertension was controlled. Mean bed rest was 5 days.

DIETARY MANAGEMENT:

Depended on the severity of oedema, renal failure & hypertension. Sodium was restricted from food till the blood pressure was controlled (no added salt), Children with a blood urea of 40 mg/dl or more were given proteins in the form of cows milk 0.5 gm/kg (21 patients) with ample amount of calories in the form of carbohydrates (honey, jam, bread).

ANTIMICROBIAL THERAPY:

On million unit of procaine penicillin was given intramuscularly once per day for 10 days to 40 patients (95.3%); two patients were given erythromycin in a dose of 25 mg/kg body weight in 4 divided doses for the same length of time because they were sensitive to penicillin.

DIURETICS:

Furosemide 2 mg/kg body weight/dose was given orally as an adjuvant therapy of hypertension & for oedema. All
**Table No. 9**

The Disappearance of Signs & Symptoms

<table>
<thead>
<tr>
<th>No of patients</th>
<th>Weeks</th>
<th>% of total</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>2 - 9</td>
<td>23.6%</td>
</tr>
<tr>
<td>26</td>
<td>3 - 4</td>
<td>65.2%</td>
</tr>
<tr>
<td>5</td>
<td>7+</td>
<td>11.2%</td>
</tr>
<tr>
<td>No of patients</td>
<td>4</td>
<td>16</td>
</tr>
<tr>
<td>---------------</td>
<td>----</td>
<td>----</td>
</tr>
<tr>
<td>Day</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>% of total</td>
<td>9.5</td>
<td>36.1</td>
</tr>
</tbody>
</table>
patients were given frusenide, the mean days of administration was 7 days.

**Hypotensive Drugs:**

Reserpine 0.07 mg/kg/dose I.M. with a maximum of 2 mg/24 hours were prescribed for 12 patients whose blood pressure persisted 4 hours after bed rest. Methyldopa 10 mg/kg/day was prescribed orally for 7 patients for an average of 5 days when reserpine failed to control the high blood pressure.
RESPONSE TO TREATMENT

Minimal criteria for recovery included regression of Signs and Symptoms, followed by two negative urine analysis.

Granular casts disappeared in 26 patients on an average of 3 days after admission.

**BLOOD UREA:**
Dropped to normal value within 2 weeks in 12 patients (28.5%) and in 3 weeks time in 28 patients (66.0%). \( P < 0.05 \)

**BLOOD PRESSURE:**
Dropped to normal value in 25 patients with bed rest and 40 mg. frusemide orally, while 12 patients required reserpine I.M. to control their high blood pressure and 5 patients out of 12 patients required methyldopa for a mean of 5 days to control their high blood pressure. \( P < 0.05 \)

**COMPLICATIONS**

Hypertensive encephalopathy was noticed in only one patient on the day of admission. The patient recovered completely without any neurological sequelae.

Congestive heart failure was evident in three patients and it was controlled by antihypertensive drugs orally and or with Digoxin.
FOLLOW UP STUDIES

Only 14 patients were followed up weekly for 6 weeks, others did not attend the referred outpatient for follow up. Urine analysis was done weekly. 7 patients had red cells of 3-8 per H.P.E. for 6 weeks and 7 had no red cells in urine. E.S.R. was within normal limits in all those who were followed up.
DISCUSSION

The results described above indicate that acute nephritis is common in Sudanese Children, of 420 children with renal problems from September 1978 to October 1979, 42 children had acute poststreptococcal glomerulonephritis. The association of a preceding streptococcal infection is well documented (Bright 1927, Longcope 1929, Seegal and Lytle 1933, Poen King 1973); however, the frequency with which the causative agent is isolated varies from 15% to 48% (Wannamaker 1970, Shame Roy 1975, Sedje 1972). The low isolation of beta haemolytic Streptococci in this study (23.6%) may be the result of widespread use of antibiotics without medical description, which is quite common in this country. However even if group A beta haemolytic streptococci is isolated, this may reflect merely a carrier state (Freedman 1970).

Further evidence of streptococcal infection is shown by the high A.S.O. titer in 93% of patients.

Of the different antibodies to the streptococcal extracellular antigen, the A.S.O. titer is generally accepted as the most reproducible and the easiest to estimate.
Approximately 80% of the patients with streptococcal infection or their complications will show elevated A.S.G. titer (Philip Freedman 1970). The A.S.G. titer usually starts to rise one to three weeks after streptococcal infection and reaches its peak in three to seven weeks, followed by gradual decline at a variable rate, an elevated A.S.G. titer indicates the presence of a previous infection but normal titer does not exclude recent infection (Freedman 1970). This statement was verified in this study were 4.7% of patients were found to have normal values. Freedman found up to 10% of normal values with well established cases of poststreptococcal glomerulonephritis. So, reliance on A.S.G. titer alone will not detect all cases of streptococcal infection. This point is particularly important since non streptococcal infections (Presumably viruses) may be associated with nephritis. For this reason consideration should be given to determination of one of the streptococcal antibodies, anti-NAD ase which is a better indicator for infection of throat and anti DNA ase B for patients with pyoderma. However, these tests could be estimated in only certain highly specialized centres; so their estimation was not possible in our laboratories.

The association of poststreptococcal acute glomerulonephritis with a preceding streptococcal infection is further documented in this study by a latent period of
7 days following sore throat and mean of 10 days following pyoderma. These figures were much shorter than what was found by Wannamaker. However, several factors contributed to the difficulty of defining this time interval. Many patients were vague about the exact onset of sore throat or pyoderma; perhaps even more significant was the uncertainty concerning the precise time of onset of either clinical or urinary abnormalities.

Most of the research workers noticed that the total haemolytic complements and C3 levels are usually reduced and that the early complement levels C1 & C4 are either normal or depressed transiently. C3 level was estimated in only 4 patients and was found to be slightly depressed in all of them to 99 mg/1. Ruben states that normal C3 level is still compatible with diagnosis.

There is no doubt that epidemiologic factors relating to the incidence and management of haemolytic infections play a most important role in the occurrence of acute nephritis. The incidence depends on a variety of socio-economic factors which turn undoubtedly determine its frequency and importance as a cause of renal disease. This is well reflected in this study where 97.6% of patients belonged to low Social Class living in the most crowded and unhygienic areas in Khartoum.
57.4% of nephritis occurred in the cold season where the upper respiratory tract infection is most common, probably due to decreased host resistance, but on the other hand it occurred all the year round, nephritis following pyoderma occurred in four out of six patients in the hot season but it also occurred in cold season. Infected scabetic lesions are said to be much more common cause of nephritis in the tropics (Swartman 1973), but no single case of scabies was observed in the study group. Neither epidemics, nor second attack of nephritis were observed.

The mean age group was found to be 8-5 years which is much higher than what was found in temperate climates which is 6-5 years although the range of the age groups were similar. This might be due to the fact that not all patients seek medical advice in this country; many of them are not referred to the paediatric referred outpatient being treated either by the medical assistant in the health center or by local medicine.

Females were found to be predominantly affected than males with a ratio of 2:1 despite the fact that there is no difference in the incidence of either streptococcal pharyngitis or pyoderma in both sexes. In temperate climates the same ratio was found; however, Hutt & White (1964) found in Uganda that both sexes are equally affected. No satisfactory explanation of to this sex difference distribution could be stated.
The clinical presentation varied significantly in the degree of severity and the extent of various manifestations from mild to an extreme clinical disorder. The onset was abrupt in all cases; the earliest and constant symptoms being dark coloured urine, periorbital oedema and oliguria, Anuria was not noticed in any patient. Oedema and haematuria are the most common presentation (Levy 1977). Oedema of the legs, although mild, was evident in 50% of patients by clinical examination. Massive fluid accumulation was uncommon. The distribution of Oedema fluid is largely influenced by two factors: gravity & local tissue tension. The characteristic involvement of the face seems to be entirely the consequence of patients ability to assume the recumbent position without discomfort and of the ready distensibility of the soft tissue of the eyes. This view is borne out by the clinical observation that facial oedema is most prominent on awaking and tends to disappear after the patient has been up to a few hours.

Gross haematuria which is one of the initial symptoms, occur in more than two thirds of patients, in most instances it diminishes after a few days (Mallet 1977) or at
most several weeks (Shane Roy 1975). Microscopic haematuria can be found for a much longer period and usually persists even after the significant proteinuria has disappeared (Bodge 1968). In this study gross haematuria disappeared in 9 days in all patients and microscopic haematuria persisted up to 6 weeks after the subsidence of clinical and laboratory evidence of acute nephritis in 7 patients out of 14 patients who were followed up regularly for 6 weeks. In some however, microscopic haematuria persists for several years after the significant proteinuria has disappeared (Naurice 1963).

Gastrointestinal symptoms were frequent. Abdominal pain was the commonest (40.2%) less common were nausea, vomiting (28.5%) and abdominal distension 14.2%. Abdominal pain was accompanied by tenderness on abdominal palpation and percussion over the costovertebral angles. The pathogenesis of pain may be probably attributed to stretching of the kidney capsule secondarily to swelling of the renal parenchyma. Urgency or dysuria were not observed in any patient. However, their presence indicate super imposed urinary tract infection.

High fever and chills occur infrequently during the acute phase and their presence indicate infection in other areas. Low grade fever occurred in a high proportion of patients (47.6%); but it is not clear whether fever occurred
simply in response to inflammatory reaction in the renal parenchma or due to some concealed mild infection elsewhere in the body. However, with the initiation of penicillin therapy, it disappeared quickly.

Normal or mildly decreased haemoglobin levels (8 gm/dl to 12 gm/dl) may be found mainly due to expansion of the extracellular volume (Rubin 1975). In this study severe hypochromic anaemia was found in 16 patients constituting 38% of the total number. Hypochromic anaemia was evident by peripheral blood examination. The other patients have normochromic anaemia and no treatment was necessary.

Acute congestive heart failure was evident clinically in three patients. However, cardiosmply and pulmonary congestion are seen in about 11% of children with acute nephritis (Levy 1971). Pulmonary oedema and heart failure reflect merely fluid retention and so it is not responsive to digitalis (Fleischer 1966) but that diuresis are also ineffective because of the decreased glomerular filtration rate. The three children who presented with congestive heart failure had hypertension. No cardiac lesion was detected in any one of them. All of them received frusemide orally together with aldomet, however, digoxin was
given to only two of them. The end result was the same in
the three children and it seems that digoxin might not be
necessary in controlling heart failure. However, because
the number of patients observed was small, no conclusive
results could be drawn from this study.

Blood pressure in acute glomerulonephritis may
be normal (Rubin 1975) but in the majority of patients it
is moderately raised. However, there is a considerable debate
about the normal levels of blood pressure in children. Most
authors (Goetzsch 1971, Nelson 1975, Shane & Young 1975) consider
a blood pressure of 140 mm of Hg or more as a definite evidence
of hypertension which requires medical intervention. Others
(James 1972) would not treat hypertension unless the diastolic
pressure exceeds 100 mm of Hg in children or there is evidence
of hypertensive encephalopathy in adults. Hypertensive
encephalopathy has been reported to occur in about 5 - 10% of
patients with acute glomerulonephritis (Maurice 1963). In
recent years there has been a decrease of this complication,
probably because hypertension can be promptly and effectively
controlled by means of newer antihypertensive drugs. In this
study only one patient presented with signs of hypertensive
encephalopathy. However, many patients presenting with severe
hypertension did not suffer from encephalopathy and as stated
by Goetzsch it seems that there is a poor relationship between
the severity of nephritis and encephalopathy.
CASE REPORT

Amani S.E. 12 years old was referred to the pediatric casualty on 4/3/1979 from Khartoum Health Centre with a provisional diagnosis of hypertensive encephalopathy. She was given 0.5 mg of reserpine I.M. before referral. The main complaint according to the parents was sudden onset of generalised convulsion on the day of admission and loss of consciousness. 15 days before this episode, she had red coloured urine, oedema of the face especially in the morning, persistant frontal headache, bilateral loin pain and tonsillitis. She was given 5 infections of procaine penicillin I.M. at home by a nurse. On admission the blood pressure was 660 mm Hg and 770 and biochemical evidence of acute nephritis. Serpamill 1mg I.M. and 80 mg of frusemide I.V. were given together with 5 mg of dianoxam I.M. Bed rest and salt restriction was advised. Protein was not restricted as her blood urea was 38 mg/dl. Six hours later blood pressure was found to be 160 mm Hg, another dose of 1mg reserpine I.M. was given. The next day blood pressure was 190 mm Hg Frusemide 40 mg orally. Aldomet 75 mg orally in three divided doses and dianoxam of 15 mg/day were prescribed. This regime of treatment continued for 3 days blood pressure dropped to 120 mm Hg, aldomet was reduced to 250 mg for another 5 days and was stopped when the blood pressure dropped to 120 mm Hg. Frusemide and valium were continued however, for another 5 days and stopped.
Hypertension was severe (diastolic pressure of 100 mm Hg or more) in only 12 patients out of 36 patients presenting with hypertension, while in the majority (i.e. 24 patients) it was mild. Seven patients presented with normal blood pressure.

Blood urea was raised only moderately in the majority of patients (81.2%). Severe electrolyte disturbance is unusual in acute nephritis since there is usually modest impairment of renal function (Dodds 1969, Hallet 1977, Shone Roy 1975). In contrast to this statement high blood urea ranging from 80 mg/dl to 220 mg/dl was evident in 7 patients. This might probably be due to the late reference of these children. Blood urea dropped to normal values in all patients within 4 weeks except in one patient who presented initially with a blood urea of 220 mg/dl and left hospital when the blood urea was 100 mg/dl.

Hyperkalaemia was not observed in any one patient either clinically or biochemically. Hyperkalaemia occurs if the kidneys fail to excrete potassium in adequate quantities and a shift of potassium occurs from intracellular space. Hyperkalaemia is life threatening and should be promptly and vigorously treated.

Although all patients presented with oedema and oliguria hyponatraemia was not evident clinically.
Serum albumin level was moderately low in 8 patients. This reduction appears to be due to low nutritional status of these children together with expansion of blood volume due to fluid retention. However, the albumin level was above 2 gm/dl in all patients. In most patients (95.7%) the quantity of protein lost in urine was relatively small, less than 0.5 gm/day. This loss does not contribute significantly to the reduction of serum albumin. Occasionally patients with acute nephritis may have massive proteinuria and in such patients serum albumin may fall below 2 gm/dl and the presenting symptom in such patients is massive oedema (Shane Boy 1975). This was not observed in any patient in this study.

There is nearly always an increase in E.S.R. in early phase of the disease (Nelson 1975). Values between 25 mm/hour and 125 mm/hour was found in all patients. In all patients on discharge E.S.R. dropped significantly but none of them returned to normal value. The initial rise of E.S.R. has no prognostic significance and E.S.R. returns to normal before healing takes place while in others it remain elevated even after evidence of renal disease has disappeared (Murphy 1942) and it remain high in many patients whose renal disease eventually become chronic (Gallis & Kagan 1971).
Therapy is directed to the correction of the physiologic abnormalities that may be life threatening i.e. the treatment of acute symptoms and complications so that progression toward restoration of health is as rapid as possible.

Bed rest is perhaps the most controversial therapeutic modality. It was once considered appropriate to maintain bed rest until all signs of nephritis has passed. McCready modified this belief and states that patients could be ambulated as soon as the signs of acute stage has passed. Because the mean age group of patients was 8.5 years many patients did not remain at bed although this was desired. So, a conclusive conclusion could not be derived from this study whether bed rest beneficial or not.

Dietary restrictions in acute nephritis depend on the severity of edema, renal failure and hypertension. Protein intake was restricted to 0.5 gm/kg/day when the blood urea was more than 40 mg/dl. Protein were given in the form of cows milk only. Ample calories in the form of carbohydrates (bread, jam & honey) were given to reduce catabolism. However, some authors (Lieberman 1973, Lewy 1967) limit protein intake only when the blood urea is more than 75 mg/dl.
Sodium restriction was induced in the presence of hypertension and in patients with oedema. Sodium intake is limited to 1 gm/day by some authors (Lieberman & Donnell 1965), while others suggest more severe sodium restriction in the presence of oedema (James 1972) Trygstad & Anand (1972) suggest simply no added salt diet. This suggestion was fulfilled in this research because it was simple and easy to carry out.

Fluids were restricted in the presence of severe oedema and oliguria. The easiest way to maintain fluid balance is to give the patient fluids amounting to insensible water loss plus measured urinary output i.e. 500 ml + Urinary output (Nelson 1975). However, due to the excessive loss of water by perspiration in our hot climate the least amount of fluids given was one litre.

Because the incidence of positive throat or skin culture in acute gonococcalnephritis is low, some recommend a 10 day course of penicillin or an appropriate substitute to all patients with nephritis. In this study a 10 day course of one million unit of procaine penicillin I.M. once per day was given to 40 patients and erythromycin orally to two patients who proved to be sensitive to penicillin. Penicillin was used because beta streptococci is sensitive to it; on the other hand it is the cheapest antibiotic and is available all the year around.
The evidence that the antimicrobial therapy will affect the prognosis of the disease is sparse (Kassier 1971); but on the other hand the use of antibiotics prevents suppurative complications and further spread of streptococcal infection. Some authors suggested the use of penicillin in the healing phase. (Gellis & Kagan 1971), but the usage does not appear to affect the outcome.

Diuretics were used to induce diuresis in all patients because all of them were oliguric on admission to hospital. Diuretics (frusemide) were also used as an adjuvant to therapy of hypertension. The effectiveness of induction of diuresis by frusemide in reflected by the short time interval in which maximal diuresis was achieved (maximum of 9 days).

Hypertension could not be controlled by bed rest and diuretics alone in 12 patients out of 36 patients who were hypertensive. In these cases reserpine was added and it was effective in lowering the high blood pressure in 5 patients, where methyldopa was added no side effects of both were noted.

The clinical signs and symptoms disappeared in a relatively short period of 4 weeks in almost all patients (88.8%) and longer than this period in 5 patients only.
PROGNOSIS:

The long term prognosis of acute glomerulonephritis in this study can not be predicted, although at discharge from the hospital 81 patients recovered completely from the acute stage and one left the hospital without completing treatment. Follow up studies were carried out regularly in only 74 patients and no signs of chronicity was observed in any patient.

However, the prognosis remain controversial. Most of the authors (Liebermann 1973, Law 1971, Nelson 1973) have concluded that at least 90% will show complete recovery. On other hand Potter and her colleagues (1978) noted persistant disease in almost 10% of children after an epidemic in Trinidad; while Baldwin in 1974 reported clinical & histological evidence of disease in 40% of children 2 or more years after the onset. Dodge in 1968 found that in 11% of patients healing did not occur within 3 years; however, he correlates prognosis both to age and renal function status at the onset; prognosis was excellent in preschool children, whereas in older children prognosis was more closely related to morphologic severity.

CONCLUSION

42 children with acute poststreplococcal glomerulonephritis were studied. The age group ranged from 3 years to 14 years with a mean age of 8.5 years, with a male to female ratio 2:1.
latent period of 7 days and in 6 patients following pyoderma with an average latent period of 10 days.

Acute poststreptococcal glomerulonephritis occurred sporadically all the year round with maximum incidence in cold season (December and January).

Beta haemolytic streptococci was isolated from the throat of 10 patients (23.4%) no positive culture was obtained from the skin. A.S.O. titer was above 250 Todd units in 39 patients (92.8%) and insignificant rise of A.S.O. titer was observed in 2 patients (4.7%). C3 complement was estimated in four patients and a mean level of 99 mg/ml was noticed i.e. slightly depressed.

23 children presented with moderately raised blood pressure; seven patients with severe hypertension and 7 children presented with normal blood pressure. Hypertensive encephalopathy was evident in one patient who responded dramatically to treatment with frusemide I.V., reserpine I.M. and aldomet orally.
The most common clinical presentations were periorbital oedema, haematuria and oliguria; these were observed in all patients. Three children presented with signs and symptoms of congestive heart failure, two of these were given digoxin together with diuretics and antihypertensive drugs; digoxin was omitted from the third patient but response to treatment was the same.

Gastrointestinal symptoms were variable; it included nausea vomiting, abdominal pain and abdominal distension.

No severe biochemical disturbance was observed. Blood urea was below 60 mg/dl in the majority of patients 81.2%. Serum albumin was moderately low in 19% of patients and none of them presented with nephrotic signs. Potassium level was within normal limits in all patients and none showed signs of hyperkalaemia.

Moderate hypochromic anaemia was observed in 33% of children and the others showed normochromic anaemia. E.S.R. was elevated in all children on admission. On discharge E.S.R. dropped significantly but normal values were not reached. White blood cell count was within normal limits in 97.2% of patients and slightly raised in 7.2%.
Response to treatment was evidenced by normalization of the biochemical signs and symptoms and normal blood pressure. All children recovered within 4 weeks; however, microscopic haematuria was observed in seven patients out of 14 for 6 weeks. All patients recovered from the acute episode. No deaths were observed.
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