RENAL EFFICIENCY IN SCARLET FEVER OCCURRING DURING CHILDHOOD

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The following is an account of Renal Efficiency from observations made in 80 cases of Scarlet Fever in children of twelve years and under.

The technique followed in order to test the Renal Function is that of McLean (1).

The urease method for estimating the concentration of urea in the blood and the hypobromite method for urea in the urine were employed.

In each case a preliminary estimation of the percentage urea concentration in a 24 hour specimen of urine was made.

Prior to the actual test all fluids were withheld for at least ten hours, after which the patient was made to pass water. This was followed by a 15 gramme dose of urea in 100 c.c.of water. Specimens were obtained at one, two and three hours. After the administration of urea and a specimen of blood was withdrawn from the patient between the second and third hours. These were then subjected to the examinations as specified above. The urea concentration Factor was obtained as indicated by McLean, by dividing the urinary urea figure by the Blood Urea figure. G.A.Harrison (2) suggests that the figures obtained in the specimen passed during the third hour should be used as the numerator, he also says that in the majority of cases which have had 15 grammes of urea administered by/

by mouth, the percentage of urea in the urine during the second hour reaches its maximum and remains so during the third hour.

In the present series the figures in the second hour specimen were taken as the numerator, the second hour specimen on the whole being in most cases more constant and reliable. The clinical symptoms and blood pressures are recorded in each case together with the microscopic and chemical findings in the urine in addition to the Renal Efficiency at that particular time.

It has been proved that urea is chiefly an exogenous product and therefore according to many authorities the urea in the blood varies with the diet.

In order to eliminate the element of error due to diet practically all the cases with a very few exceptions were on milk diet and had been for some days previously.

According to McLean a normal kidney should not excrete less than 2 per cent. urea at the end of the second hour, after a 15 gramme dose of urea, provided there is no diuresis.

Harrison considers diuresis to be present when more than 150 c.c. of urine are passed in the first hour and more than 100 c.c. in the second. Harrison also states, that after a 15 gramme dose of urea if the urea concentration (urine) at the end of the first, second or third hour, exceeds 2.5 per cent. it is "normal" i.e. probably more than one quarter of the total kidney tissue was functioning on the day of the test.

If the concentration lies between 2 and 2.5 per cent. it is probably/

probably "normal", but if the urea concentration is below 2 per cent. the renal condition may be definitely unsatisfactory, less than one-quarter of the kidney functioning.

Sometimes so much urea has been passed in the first, or in the first and second hour, that there is not sufficient "head" to cause concentration in the third.

In a few cases obviously suffering from renal trouble a normal urea excretion has been found in the urine. This is stated to be probably due to the urea concentration in the blood being sufficiently high to produce a normal concentration in an inefficient kidney. The essential difference between the two cases i.e. the normal kidney excreting over 2 per cent. urea and the diseased kidney with apparent normal excretion is that in the healthy person the urea is excreted from the blood containing the normal amount of urea, while in the nephritic the blood contains excess of urea. (6)

McLean considers that the blood urea in normal cases should on ordinary diet not exceed 15 to 40 milligrammes per 100 c.c. and rather less in children. Blood urea should be 20 times less concentrated than urinary urea (4). Harrison says it is generally considered, that if the concentration of urea in the urine is above 2 per cent., the blood urea ought to be below 40 milligrammes per 100 c.c.of blood. He finds that that is not always the case and other writers also confirm this view, by saying that factors other than diet and kidney might influence the amount of urea in the blood (2). Sufficient work has not yet been done in order to gauge what is about the normal/

normal urea content of the blood in normal adults and children, two and a half hours after a 15 gramme dose of urea.

Harrison has obtained various results in normal adult patients with a urea concentration over 2 per cent. These results varied between 37 milligrammes to 133 milligrammes per 100 c.c. of blood. The urea concentration Factor also varied very much in the same cases, varying from 72 to 18. The above facts are stated in view of the presence of certain anomalous findings in the series of cases now reported.

As a basis for the classification of the cases, the microscopic and chemical findings in the urine were relied upon.

Group I. "normal Urines" and the following groups have been distinguished.

Group II. "Albuminurias" which in turn have been subdivided into "albuminurias with normal urea Concentration" and "Albuminurias with deficient urea concentration".

Group III. "Albuminurias with casts".

Group IV. "Albuminurias and Haematurias".

Group V. "Albuminurias, Haematurias and Casts".

Group VI. "Pyurias".

The following table (Table A) shows the results obtained in 10 cases of Scarlet Fever in which the urines presented no abnormalities of any kind at the time of examination. It will be noticed that the day of illness on which the urines were examined and the U.C.F. calculated varied considerably in the different/

different cases, ranging from the fourth to the forty-ninth day. The U.C.F. varies from 20 to 63 and the Blood Ureas from 46 to 116 milligrammes per 100 c.c. of blood.

In several cases Pyrexia was still present, when the experiment was carried out. Some of the cases were acutely ill and the others mild. Nine cases out of ten show a normal urea concentration in the second hour. This result is interesting in view of the fact that Cases IV, V, and VI had albumen present at a later period of the disease.

In case IV Albumen appeared six days after the result was obtained and three in Case V, albumen appeared one day after the experiment in case VI. In Case III there is an obviously low figure in the 1st and 2nd hour and an unduly high figure in the 3rd hour. As there was no diuresis, the suggestion is that there was some difficulty in concentrating even during the first and second hour. The third hour concentration is well over 3 per cent. and the 24 hours specimen is normal. The patient's general condition throughout the illness was satisfactory, the Blood Urea fairly low and theU.C.F. not too low.

All these facts point to the exclusion of any inefficiency on the part of the kidneys. The urea concentrations are all normal in the third hour. Seven cases show normal concentration in the first hour and six in the 24 hours specimen.

So far as the Blood Urea concentration is concerned, Cases I, and II show a high figure but the Primary Pyrexia had not subsided in these cases. The urinary area was normal.

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The low U.C.F. in Case I might lead one to surmise a defective renal function, and attribute the normal excretion of urea by the kidneys to the high blood urea content in the blood. The patient's general condition, however, indicated no renal inefficiency. The only explanation that offers itself in a case like I is that the high blood urea figure might be due to the activity of the patient's metabolism during the Pyrexia.

Urates were present in the urines of both I and X (24 hours specimen). The urine passed during that time was normal for I but diminished in X,[9] which indicates that the breaking down of non protein nitrogen is much greater in I than in X.

Cases I, II and X were all on milk diet and duration of illness did not exceed five days. Caigen notes that at first the amount of urea excreted is in proportion to the height of the temperature, and that with a temperature of 103°, it might be as much as 4 per cent. Later on this relation is lost and the amount of urea falls from the fourth day[8].

Cases VII, VIII and IX were mild cases, urea concentration in urine, blood urea and U.C.F. satisfactory. All the cases made good recoveries.

Conclusions.

In this series of cases, there is no evidence of Renal Inefficiency in patients suffering from uncomplicated Scarlet Fever.

TABLE A.

Normal Urines Group I.

No.	Age.	Sex.	Day of illness on wh. urine was examined.	Blood pressure.	Urea per cent. and c.c. of urine.				Blood urea.	U.C.F.	Microscopic examination.
					24 hours.	1st. hour.	2nd. hour.	3rd. hour			
					% c.c.	% c.c.	% c.c.	% c.c.			
1	5½	F	4	110/75	2.00 - 575	2.50 - 56	2.40 - 85	3.12-56	116	20	Urates +++
2	5	M	5	105/75	1.90 - 580	2.37 - 60	2.27 - 58	2.80-59	86	26	-
3	4½	F	12	90/75	2.30 - 560	1.75 - 85	1.65 - 85	3.25-113	50	33	-
4	12	F	4	95/65	1.55 -1164	1.30 - 113	2.65 - 84	2.50-113	65	40	Uric acid crystals.
5	12	F	39	115/95	2.25 - 680	1.50 - 56	2.80 - 56	2.97-70	58	48	-
6	6½	F	5	90/60	2.65 - 280	3.13 - 28	3.40 - 42	2.50-112	68	50	-
7	8	F	5	80/60	1.80 -1080	2.45 - 56	2.55 - 42	2.80-56	46	55	-
8	3½	M	11	80/45	2.13 -1120	2.65 - 28	2.80 - 56	2.35-112	50	56	-
9	12	F	49	98/65	1.05 - 985	2.65 - 56	2.90 -113	3.20-56	59	59	-
10	11	F	5	90/65	4.00 - 865	2.65 - 56	3.00 - 56	3.15 -60	47	63	Urates ++

Albuminurias, Group II.

This consists of 26 patients in whom the only abnormality in the urine was the presence of albumen. In the cases examined, the day on which the experiment was conducted varies considerably, depending upon the time at which the albuminuria appeared. No casts were found, in spite of repeated examination. The albuminurias have been subdivided into two sections, the one consisting of cases with a normal excretion of urea in the urine and the other in which the urea excretion was defective. The following cases belong to the group in which the urea excretion in urine was over 2 per cent. (Table B).

Cases X, XII, XIII were admitted with albuminuria. Total duration of albuminuria in these cases was 7, 11 days and 5 weeks respectively.

Adenitis was present in all 3 cases. Adenitis and albuminuria cleared up simultaneously. Urea excretion was normal in 1st, 2nd and 3rd hour specimens in spite of diuresis.

Cases I, VII, XI showed normal urea concentration in 1st, 2nd and 3rd hour.

I and XI had albumen on admission. I was clear of albumen within 13 days and XI within 8 days - no complications.

VII developed albuminuria on the 11th day, urine clear 3 days later. No complications.

Cases II, V, VI, VII, IX had albumen in the urine on admission, with the exception of VI, who developed albuminuria on the 38th day, this persisted only 48 hours. All five cases excreted over

2 per cent. during the 2nd and 3rd hour.

Case II. had there been no diuresis, would probably have had a greater concentration.

No.II and IX were acute cases of Scarlet fever, duration of albuminuria was 5 and 13 days respectively.

Nos.V,VI,VIII were mild cases of Scarlet Fever. Total duration of Albuminuria in V. was 3 days, 2 days in VI. and 10 days in VIII.

Case III developed albuminuria on the 3rd day of illness, urine clear 5 days later. Case IV developed albuminuria on 10th day. Urine clear on 15th day of illness. Both cases III and IV concentrated over 2 per cent. during 2nd and 3rd hour. Convalescence was complicated by otorrhea, rhinitis and adenitis in the former, and rhinitis in the latter. Discharges still present on dismissal. In the preceding cases, it will be noted, that there is no evidence of renal impairment. Blood ureas were fairly high in Cases I,II,III and U.C.F. low, but cases were still in their first week of illness. The majority of patients were admitted with albumen in the urine.

All albuminurias cleared up within a fortnight from onset, whether complications were present or not,with the exception of Case XIII.

Case VI is the only case in the present series that developed albumen after the second week of illness.

In several instances albuminurias and complications cleared up together, which suggests that complications might be the cause of albuminuria.

The/

TABLE B.

No.	Age.	Sex.	Day of illness on which urine was examined	Blood pressure.	Proteins	Percentage of urea and c.c. of urine.				Blood urea	U.C.F.	Microscopic examination
						24 hours.	1st. hour	2nd. hour	3rd hour			
Group 11. Albumenurias with normal urea concentration												
1	7	F	5	85/60	slight trace	1.37 - 7I2	2.50 - 56	2.45- 7I	2.30 -56	86	22	
2	9	F	4	90/70	"	1.37 - 170	1.25 -168	2.10-168	2.25-113	75	28	
3	6	M	8	90/60	"	1.33 - 856	1.90 -70	2.40- 90	3.00- 75	81	29	
4	12	F	12	110/65	Moderate	1.15 -1126	1.75 -50	2.15- 55	2.20- 70	62	34	
5	8	F	5	110/70	slight trace	-	1.21 -56	2.57- 85	3.13- 70	70	36	
6	10	F	39	90/65	Trace	0.75 - 512	1.70 -84	2.80- 56	3.13- 84	72	38	
7	8	F	13	90/65	Slight trace.	1.85 - 625	2.87 -52	2.85- 30	3.50- 60	66	43	
8	12	F	6	110/75	Trace	0.93 - 438	1.85 -29	2.33- 37	2.55- 41	47	49	
9	8	F	10	90/65	Moderate	0.72 - 834	1.56 -56	2.13- 84	1.60- 42	43	49	
10	9½	M	5	110/68	Trace	3.00 - 802	3.20 -56	3.30-113	3.25-226	58	56	urates.
11	12	M	7	110/70	"	0.90 - 821	2.25 -45	3.15- 53	2.65- 50	51	61	
11	12	F	5	110/80	Slight trace	2.63 - 284	3.15 -50	3.20- 58	3.20- 45	48	69	abundant urates.
13	9	F	5	90/65	Moderate	3.53 - 208	2.87 -142	3.13- 113	3.10- 56	36	86	

The following 13 cases of albuminuria without casts and in which the urea concentration was found to be deficient, belong to group II (Table C).

Case XII exhibited some unusual symptoms. The patient was a delicate looking child. The boundaries of the heart were normal. There was a systolic murmur at the apex. The pulse pressure was normal and no evidence of ~~hidrosis~~ lordosis.

Patient was admitted with albumen present in the urine, on the third day of illness. No history of albuminuria could be obtained, previous to admission to hospital.

Albumen in the urine persisted off and on during the whole of patient's residence in Hospital. The quantity of albumen varied from day to day, at times the urine was clear even when the patient was up.

A substance said to be characteristic of "orthostatic" albuminuria when found in excess and precipitated by 30% Acetic Acid in the cold, was seen in excess when urine was examined. This substance is regarded as Globuline by McLean[1] Chondroitin-Sulphuric Acid united with Serum- Albumen by Holt[9] and Mucin, Nucleo-Albumen and Euglobulin by Hursfield.[10]

In spite of repeated examinations, no casts were found.

Posture, diet, pyrexia and the suppurating adenitis and otorrhea which unfortunately complicated convalescence did not have any influence on the albuminuria. There never was any evidence of oedema. Patient was finally dismissed well in every way in spite of the persistent albuminuria. From the history subsequently obtained, albumen was still in evidence two

months/

months after dismissal. It will be noticed that the low output of urea coinciding with the fairly low U.C.F. suggests some renal mischief, although a body was found in the urine characteristic, according to some authorities, of orthostatic albuminuria.

Case X shows deficient urea excretion in the 1st, 2nd, and 3rd hour, though excretion is normal in a 24 hours specimen and urates were found in abundance in the last mentioned specimen. The blood pressure was fairly high and U.C.F. inclined to be low.

Child was admitted on the 3rd day of illness, with adenitis. Urine was thick with albumen, this clearedup in about a fortnight.

Cases IX and XIII were admitted in a state of desquamation with albumen in the urine and oedema. The albuminuria lasted 8 days in IX and 16 in XIII.

Case IX developed otorrhea and rhinitis during convalescence, urea excretion was normal during the 3rd hour but blood urea was high and U.C.F.low, there was also clinical evidence of nephritis.

Case XIII had enteritis on admission, which persisted for three weeks. Otorrhea developed on 16th day of illness. Both blood urea and urea concentration in urine are low, indicating the possibility of a defective assimilation and excretion of urea.

Both cases made good recoveries.

Cases III, V and VIII. All had albumen on admission which lasted for over three weeks. All three cases had complications in the form of rhinitis, otorrhea and adinitis.

Urea concentration, blood urea and U.C.F. are all abnormal in

Case/

case III.

Cases V and VIII show diuresis, this might in both cases be the cause of the low urea output in the urine.

Case V shows a much higher blood urea and a lower U.C.F. than case VIII, but Case V was still in the first week of illness, when urine was examined. In the present series of cases, a high blood urea was very often found in patients suffering from Scarlet Fever, during the first week of illness. All these cases made good recoveries.

Case VII was a mild case of Scarlet Fever. Albuminuria was present on admission andonly persisted for 14 days.

Urea concentration in urine is defective in each specimen. Blood urea is fairly normal. U.C.F. low and blood pressure high. Patient was dismissed well.

Cases IV and VI developed albumin-urea during the third week, there were no other complications, and urine was clear within a week. Urea concentration in urine, blood urea and U.C.F. are all unsatisfactory. Patients dismissed well.

Cases I,II and XI had albumin on admission; this persisted only a few days.

Albuminuria again developed during the third week. No other complications, no rise in temperature. In all three cases, urea concentration, blood urea and U.C.F. are abnormal. Patients were all dismissed well.

Albuminuria was present on admission in eleven of the thirteen cases just mentioned. In every case developing albuminuria/

albuminuria in the 3rd week, the urea concentration was below 2 per cent. This includes two cases admitted in a state of desquamation, in whom Scarlet Fever must have been present for about three weeks. Every case in which albuminuria was present on admission and persisted into the third week showed a deficient excretion of urea.

Cases VII and X were examined during the first week of illness, but at that time the Blood Pressure was high in both cases.

A great deal of controversy exists as to the significance of albuminuria in Scarlet Fever.

That the presence of albumin does not afford much help is obvious, when one considers and correlates all the symptoms.

Further the extent of the albuminuria is of little value as an index to the gravity of the case, for it is well known that themost serious cases may show but traces of albuminuria. According to Kerr, albuminuria is not uncommon in patients suffering from Scarlet Fever with high temperatures and need not be regarded seriously.

Kerr and Holt do not think that the kidneys suffer any more at this initial stage of Scarlet fever, than is common in many other acute febrile conditions and that this early albuminuria has no relationship to the nephritis of convalescence. The most puzzling cases, are those albuminureas which occur insidiously during the third week of illness. Are they to be regarded as true nephritis or merely as transient albuminurias? The problem becomes still more complex, if at that time the patient develops adenitis/

adenitis, rhinitis, etc or any other complication, mild or otherwise, which so often accompanies convalescence. Those conditions often run parallel with a certain amount of albuminuria. Kerr practically concludes that albuminurias and mild cases of nephritis, occurring in the third week, differ only in one degree, as the cause of kidney inflammation is due to the irritation by toxins, not more abundant at that period than at any other, but being excreted in greater quantity at that particular time.

He also says that albuminurias occur more frequently after the age of ten, than true nephritis, the latter occurring mostly between the ages of five and seven.

Among the 26 cases of albuminuria recorded 22 had albumin present on admission. Of these 22 cases mild and severe attacks of Scarlet Fever were equally represented. The duration of this albuminuria differed considerably in each individual case. All the cases but one were free from albumen on dismissal and all made good recoveries.

Six of the 26 cases yielded over 2 per cent. concentration in the first hour, 14 in the second hour and 14 in the third hour.

Four cases showed a normal urea concentration in the 24 hours specimen.

In each of these four cases, the urine was examined on the fifth day of illness, and primary pyrexia had not subsided. Three of the four specimens contained urates.

Conclusions.

In the preceding 26 cases, girls appear to be more susceptible to/

to albuminuria than boys, the majority of the patients affected were over eight years of age.

A. The urea concentration in the urine was found to be under 2 per cent. in

(1) Cases of albuminuria developing during and after the third week of illness.

(2) Cases of initial albuminuria persisting into the third week and after.

(3) Cases of albuminuria with clinical signs of nephritis.

B. The urea concentration was found to be over 2 per cent. in

(1) Initial albuminurias in which there were no signs of nephritis and in which the duration of the albuminuria was short.

(2) Cases of albuminuria developing before the third week of illness.

TABLE C.

Group II.	No.	Age.	Sex.	Day of illness on which urine was examined.	Blood pressure.	Protein.	Percentage of urea and c.c. of urine. 24 hours	1st. hour	2nd. hour	3rd. hour	Blood urea	U.C.F.	Microscopic examination
Albumenurias with deficient urea excretion	1	3	M	25	110/70	Trace	0.73 -230	0.81- 56	1.16- 28	1.05- 14	56	20	
	2	12	M	23	110/75	"	1.40-280	0.83-120	1.31-113	1.87- 60	56	23	
	3	10	F	53	110/75	"	0.50-568	0.25- 58	1.70- 40	1.70- 45	67	25	
	4	11	F	19	90/65	"	1.25-896	1.20- 56	1.87- 43	1.95- 56	69	27	
	5	11	F	16	95/35	Moderate	1.56-624	1.65- 85	1.91-142	1.85-113	66	29	
	6	7	F	30	105/70	Slight trace	1.50-852	1.21- 85	1.63- 56	1.72- 42	54	30	
	7	12	F	5	130/80	Trace	1.53-710	0.74- 85	1.19-113	1.08-113	39	30	
	8	11	M	18	115/ 85	Moderate	0.68-1247	1.15-227	1.91-170	1.75-113	56	34	
	9	6	F	?	115/65	Trace	1.00-560	1.50-115		3.00-142	81	37	
	10	12	F	5	120/70	"	4.00-628	1.85-60	1.95- 66	1.45- 58	51	38	urates abundant ,
	11	12	M	24	95/60	"	0.85-795	0.81-85	1.93- 85	1.60- 85	82	42	
	12	10	F	17	110/75	Moderate	1.45-1249	1.65-113	2.03- 99	1.90-113	46	44	
	13	4	M	?	110/75	"	0.90-480	1.25- 32	1.25- 40	1.85- 38	22	56	broken down epithelial cells.

Albuminurias with Casts. Group III.

The present series consist of 9 cases of albuminurias with casts. The casts were chiefly of the hyalo-granular variety. This series comes under group III. (Table D).

Case I was admitted acutely ill, as nephritis following upon Scarlet Fever total duration of illness previous to admission was five weeks. Oedema was very marked, Second Aortic Sound accentuated; Blood Pressure 120 milligrammes of mercury; Urine was scanty and loaded with albumen and casts.

Urea concentration was low in every specimen. Blood urea high and U.C.F. very low. Child lived a fortnight after admission and died of uraemic convulsions.

Post mortem showed both kidneys to be acutely congested.

On section small haemorrhages were seen in the cortex; there was also evidence of diffuse infiltration throughout the kidneys.

Microscopic examination of a section revealed acute congestion of tubules, with Hyaline degeneration of Epithelial Cells.

Some tubules appeared quite blocked with exudate and Epithelial Cells.

The capillaries of the glomerular tufts were congested and basement membrane of capsule was degenerated.

The space between the tuft and capsule was filled with proliferated cells.

Generalised cellular infiltration was scattered throughout the interstitial tissue and some of the blood vessels were surrounded by cellular exudate.

Case II/

Case II was admitted in a desquamating condition, with generalised oedema, albumen and casts in the urine.

Both conditions cleared up in about a fortnight. Patient was dismissed well.

Case III was a mild case, which developed albuminuria with casts during the third week. No other complication. Albuminuria persisted for a fortnight.

Case IV was a mild case. Pyrexia, adenitis and albuminuria with casts developed simultaneously during the fourth week and persisted for about three weeks.

All the above conditions cleared up about the same time.

Case V was acutely ill on admission, rhinitis and adenitis were both present. Albuminuria 5th day. Primary Pyrexia subsided 21st day. 24th day casts & albumen. Otorrhea 28th day. Both ears discharging 64th day. Mastoid operation 90th day. On 105th day mastoid wound had practically healed and urine was clear of albumen. Patient dismissed well, slight rhinitis.

Case VI admitted in a state of desquamation, slight oedema. Second aortic sound accentuated. Albumen and casts in the urine. Urine clear thirty-two days after admission.

Urea excretion was normal in all four specimens. Patient was probably suffering from the Hydraemic type of nephritis in which type there is no retention of nitrogenous bodies. Patient dismissed well eventually.

Case VII. Albumen and casts were present on admission and persisted all through convalescence. No oedema or complications.

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The condition was not affected by diet or posture. Amount of albumin was variable. No excess of globulins. Dismissed apparently well, albuminuria still present.

Case VIII was a mild case developed albuminuria and casts on the 44th day of illness, no other complications. Condition persisted a fortnight. Dismissed well.

Case IX. mild case. Albumen and casts present during fourth week and lasting eight days. Recovery uneventful. Dismissed well.

Cases I, II, III, VIII show a urea concentration in the urine below 2 per cent.

Cases VI and VII have a normal urea output, but the high blood urea might be the cause of this. On the other hand, Case VI appears to belong to the Hydraemic type of nephritis and case VII might be classified as a "Physiological Albuminuria" or "Albuminuria of Adolescence" there being no clinical evidence of nephritis.

In Cases II and V the temperature persisted off and on throughout convalescence. Urea concentration was normal in second and third hour but blood urea was high in both cases, this suggests renal trouble. Albuminurias, septic conditions and Pyrexia all cleared up together. This leads to the assumption in the case of IV and V that the albuminurias were caused by the above conditions.

Case IX shows normal cell round figures. In the preceding cases, urea concentration in urine was over 2 per cent. in five cases/

cases, during the second hour.

The blood urea rose to three figures in seven cases U.C.F. lay between 9 and 39.

Blood pressures were comparatively high in most cases.

All urines were examined after the third week of illness.

One case showed casts and albumen in the urine during the first week of illness, the others developed this condition during the third week and after; this includes three cases admitted with scarlatinal nephritis and seven cases made good recoveries, one died, and one was dismissed with albumen.

A point of interest in the preceding cases is the fact that a case obviously suffering from nephritis "Case VI" showed a normal urea concentration in each of the four specimens obtained.

TABLE D.

No.	Age.	Sex.	Day of illness on which urine was examined	Blood pressure	Protein.	Urea per cent and c.c. of urine.				Blood urea	U.C.F.	Microscopic examination.
						24 hours	1st. hour	2nd. hour	3rd. hour.			
Group III. Urines containing casts and albumen												
1	2½	M	?	120/75	+++	1.90-984	0.85-56	1.25-42	1.57-42	111	11	abundant gran. casts.
2	5 7/12	M	?	120/85	+	1.30-840	1.40-113	1.40-113	1.45-56	104	9	Hyalo-granular casts.
3	6	F	25	115/75	++	1.23-510	1.56-60	1.93-52	1.87-55	119	16	" "
4	12½	F	27	90/65	+	0.55-1760	2.40-28	2.45-84	2.03-56	129	18	" "
5	7	M	26	108/80	++	0.85-5604	1.85-52	2.60-70	2.90-75	131	19	Grahular casts
6	12	F	?	130/90	++	2.40-3974	2.85-113	2.55-56	2.50-85	117	21	Hyalo-granular casts.
7	8	M	36	105/75	+	1.23-850	1.41-56	2.75-85	2.25-83	112	24	" "
8	7	M	51	110/75	+	1.43-426	1.03-41	1.80-32	2.13-69	66	27	Hyaline
9	12	F	37	118/80	Trace	1.43-1022	1.65-84	2.40-68	2.50-84	61	39	Very few hyaline.

Albuminurias and Haematurias. Group IV.

This series consists of six cases in which blood and albumen were present in the urine but in which no casts could be found; in spite of repeated examinations (Table E.)

Case II was admitted on the third day of illness. Pyrexia subsided on 6th day.

Pyrexia accompanied by blood and albumen appeared on the 24th day.

Pyrexia again subsided on the 29th day. Urine clear 59th day. Patient dismissed well.

Case II was admitted on the third day of illness. Pyrexia subsided on the 7th day. Otorrhea 21st day. Pyrexia accompanied by blood and albumen in the urine 29th day. Temperature normal 51st day. Otorrhea cleared up 60th day. Total duration of albuminuria 60 days. Patient dismissed well.

Case III admitted on the third day of illness. Pyrexia subsided on the 11th day. Blood and albumen present on 19th day. Duration of albuminuria 11 days. Patient dismissed well.

Case IV admitted with Scarlet Fever and Diphtheria on the second day of illness. Pyrexia subsided 4th day of illness. Otorrhea present on 9th day. Pyrexia again recurred on 21st day. Blood and albumen 24th day. Urine clear 35th day. Patient dismissed well.

Case V was admitted in a state of desquamation. Blood and albumen were present in the urine. There was no oedema or septic conditions of any kind.

A systolic murmur was found at the apex. Urine clear

30th day after admission. Patient dismissed well.

Case VI was admitted with marked desquemation. Slight oedema but no pyrexia. Blood and albumen were present in the urine. Otorrhea developed on the 7th day of illness and rhinitis on the 82nd day. Patient was dismissed well but rhinitis was still present on dismissal.

Cases II, III and VI all showed deficient urea excretion in the urine.

Cases II and III developed blood and albumen, during the third week of illness.

Case VI showed clinical signs of nephritis; all other cases were complicated by septic conditions. Blood ureas were moderately high in II and III and U.C.F. low. Blood ureas and U.C.F. were low in Case VI.

Case I. showed a normal urea concentration during the third hour but blood urea was moderately high and U.C.F. low.

Cases IV and V had normal excretions of urea, during the 2nd and 3rd hour, but blood ureas were moderately high and U.C.F. low.

Case V had pus cells and coliform bacilli in addition to the blood and albumen found in the urine; this suggests some involvement of the bladder. The above six cases are interesting, in view of the fact that blood was found in the urine without evidence of casts.

Case V is the only case which concentrates well over 2 per cent. urea in the urine and microscopic findings suggest cystitis. The remaining cases all suggest renal impairment. Case IV ~~faulty~~/

~~faulty~~ fairly concentrated 2 per cent. urea in the urine, and case I only concentrated normally during the third hour. Cases II. III and all show deficient urea concentration. The possibility of albuminurias in which the renal function is impaired co-existing with some inflammation or disease in the lower part of the urinary tract is not improbable.

TABLE E.

Group IV.	No.	Age.	Sex.	Day of illness on which urine was examined.	Blood pressure.	Protein	Blood	Urea per cent and c.c. of urine, 24 hours	1st. hour	2nd. hour	3rd. hour	Blood urea	U.C.F	Microscopic examination
Cases containing blood and albumen but no casts.	1	8	M	29	118/80	+	+	0.90-994	1.65-112	1.90-84	2.20-112	72	26	Blood Corpuscles
	2	6½	F	38	90/65	++	+	0.50-852	1.70-57	1.20-52	1.55-73	66	28	"
	3	12	F	25	90/75	+	+	0,33-1639	0.67-1760	1.30-85	1.52-56	52	29	"
	4	10	M	25	90/75	+	+	0.60-1220	1.70-71	2.00-56	2.05-85	66	33	"
	5	6	M	?	110/75	+	+	0.80-539	1.40-28	2.45-113	2.40-56	73	33	Pus cells Coliform bacilli. Blood Corpuscles debris.
	6	6½	M	?	115/80	+	+	0.90-284	1.40-30	1.30-63	1.75-62	39	35	Blood corpuscles

Albuminurias, Haematurias and Casts. Group V.

This group is composed of cases which all show definite evidence of renal inefficiency. Blood albumen and casts were present in the urine in every case. (Table E).

Case I. was admitted desquamating. Anasarca was very marked. The urine was loaded with blood albumen and casts. Both ears were discharging. No Pyrexia. Blood pressure 100 milligrammes of mercury.

During the first week in hospital the child seemed to improve generally. Oedema became less marked and quantity of urine increased. Patient occasionally complained of headache. The blood pressure was never high. Eight days after admission patient was passing 50 oz. of urine in the 24 hours and appeared fairly well, but that night convulsions developed and patient became unconscious. Consciousness was never regained and patient died two days later. There was a rise of temperature and anuria 24 hours previous to death. A post mortem was not obtainable.

Case II was a mild case. Oedema, blood, albumen and casts in the urine all developed during the third week. Otorrhea developed on 25th day. Urine clear eighth week. Patient was dismissed well.

Case III was an acute case of Scarlet Fever. Rhinitis was present on admission. At the beginning of the fourth week patient developed slight oedema with blood albumen and casts in the urine. Albuminuria persisted for a month.

Case IV was an acute case of Scarlet Fever. Pyrexia was

present during 38 days. On the 70th day of illness, blood albumen and casts were found in the urine. Urine was clear seven weeks after onset of albumen urea. There was no more Pyrexia after primary pyrexia had subsided. Patient dismissed well.

Case V was admitted desquamating, with slight oedema and blood albumen and casts in the urine.

No accentuation of the second aortic sound. Pyrexia was present on admission. Urine was clear one month after admission. Patient dismissed well.

Case VI was an acute case of Scarlet Fever. Rhinitis and adenitis were present on admission. Primary pyrexia lasted 27 days. Albumen was seen in the urine on the 9th day. Blood and casts were noticed in the urine on the 13th day. Otorrhea developed on the 15th day. Urine clear 23rd day. Patient dismissed well; otorrhea still present.

Case VII was a mild case of Scarlet Fever. During the third week the temperature rose to 103°, oedema was present. Blood, albumen and casts, Coliform Bacilli and Pus cells in the urine all developed at about the same time. Blood persisted for four weeks after the onset of albuminuria. Albuminuria and Pyuria are still persisting at the present time, (i.e. over three months).

Case VIII was a mild case of Scarlet Fever. Blood albumen and casts developed during the third week of illness. The total duration of albuminuria only lasted one week. Patient was dismissed well.

Case IX was an acute case of Scarlet Fever. Primary pyrexia/

Pyrexia subsided 12 days after admission. Blood albumen and casts appeared in the urine during the 5th week of illness. Urine was clear 15 days after onset of albuminuria. There was no rise in temperature, after the primary pyrexia had subsided. Patient dismissed well.

Case X. Patient was admitted with Diphtheria and developed Scarlet Fever six weeks after. Blood albumen and casts were found in the urine three weeks after the onset of Scarlet Fever. Urine was clear 13 days after onset of albuminuria. Patient was dismissed well.

Case XI was admitted desquamating; there was no oedema. Blood, albumen and casts were found in the urine on admission. Urine was clear of blood one weekafter admission. Casts persisted in the urine for about 3 weeks. Albumen was present during the whole of stay in hospital. The amount of albumen was very slight on dismissal. There was no excess of globuline; posture and diet had no effect. Temperature afebrile during whole of stay in hospital. Slight rhinitis and albuminuria on dismissal.

Case XII was a fairly mild case of Scarlet Fever. Patient developed slight oedema, and blood albumen and casts in the urine, during the third week. Temperature febrile during the albuminuria. Temperature and condition of the urine subsided about the same time, i.e. during the sixth week after onset of albuminuria. Patient dismissed well.

Case XIII was a mild case of Scarlet Fever, admitted on the fifth day of illness. Blood, albumen and casts developed in the/

the urine during the third week of illness. The condition lasted a fortnight. No pyrexia. Recovery uneventful. Patient dismissed well.

Case XIV was admitted desquemating, there was no oedema or accentuation of the Second Aortic sound. Temperature afebrile. Blood albumen and casts were present in the urine on admission. Urine was clear of blood one week after admission. Urine was clear of albumen one week later. Recovery was uneventful. Patient was dismissed well.

Case XV. was admitted desquamating. Generalised oedema; systolic murmur at apex, accentuation of the second aortic sound; blood, albumen and casts in the urine, all were present on admission. Pyrexia subsided one day after admission. Urine clear on the 12th day after admission. Patient dismissed well.

All 15 cases showed deficient urea excretion in the urine in the 24 hours specimen and in the 1st and 2nd hours specimens. Twelve cases showed deficient excretions of urea in the third hour, three cases were normal Cases VII, X, and XII. Blood, urea in the majority of cases ran into three figures.

The U.C.F. in no case rose higher than 20. One case died, one was dismissed with albumen in the urine, and one case at the time of writing was still under treatment. The other 12 cases made satisfactory recoveries. The normal excretion of urea in case VII during the third hour, is probably due to the exceptionally high blood urea, and to the small amount of urine passed. Only

14/

14 c.c. being excreted in two hours. Pyrexia was also present at this time.

Cases X and XIV although the urea excretion was normal during the third hour, suggest retention of urea in the blood, as the blood urea is high and U.C.F. very low. The results obtained and tabulated in Table F. all point to renal inefficiency in the above cases.

Conclusions.

According to the 15 cases just considered, nephritis following upon Scarlet Fever occurs chiefly in children under nine years of age, most of the cases occurring between three and seven. Every case in which albumen, blood and casts were found in the urine, showed renal inefficiency, whether there were clinical signs of nephritis or not.

TABLE F.

No.	Age	Sex	Day of illness on wh. urine was examined.	Blood pressure.	Urea per cent & c.c. of urine. 24 hours	1st. hour	2nd. hour	3rd. hour	Blood Urea	U.C.F.	Blood	Protein	Microscopic examination.
1	15	M	?	100/65	0.75-560	0.35-83	1.03-56	0.75-56	146	7	++	+++	Blood, Epithelial, Gran. casts.
2	9	M	19	155/95	0.52-1012	0.80-33	1.03-62	1.25-57	126	8	++	+++	Granular and Blood casts.
3	2½	M	25	120/95	0.72-2814	1.55-30	1.75-45	1.75-48	178	9	+	++	Epethelial & Blood casts.
4	2 9/12	M	74	105/65	1.00-965	0.97-85	0.92-85	1.00-85	110	11	+	++	Epithel. Casts.
5	5	F	?	110/65	0.95-397	1.40-37	1.60-49	1.10-32	124	12	+	++	" & Gran. casts
6	2½	F	21	90/60	0.55-710	1.45-76		1.60-56	127	12	++	+++	Gran. & Epithel. Casts.
7	6½	M	23	125/90	1.83-2274	1.70-28		2.15-14	186	12	+	++	Blood & Gran. Casts.
8	6	M	23	120/75	0.32-965	1.00-85	1.61-14	1.65-63	126	13	+	++	Epithel. Blood & Gran. casts
9	5	F	31	110/65	0.53-1164	1.80-56	1.62-113		118	13	+	+++	Gran. & Epithel casts.
10	2	F	23	100/65	0.95-550	1.70-50	1.15-40	2.25-56	86	13	+	+	Gran. casts.
11	7	F	?	130/80	0.85-1136	1.50-85	1.50-63	1.32-45	108	14	++	++	Gran & Epithel-casts.
12	7	F	21	130/80	1.55-512	1.80-40	1.87-43	1.90-40	106	17	+	++	Gran. & Epithel-casts.
13	7	M	25	95/55	1.00-560	1.25-75	1.55-55	1.55-85	84	18	+	++	" "
14	12	M	?	115/75	1.16-681		1.93-594	2.06-113	99	19	+	++	" "
15	9	F	?	130/80	1.60-41	1.51-42	1.36-45	1.08-28	61	20	+	++	" "

Group V. Urines containing blood, albumen and casts.

Pyurias. Group VI.

The following are 14 cases of Pyuria, complicating Scarlet Fever. (Table G).

Case I. Admitted 3rd day of illness. Duration of primary pyrexia ten days. Pus and albumen in urine on 1st day. Condition persisted for eight weeks. Patient dismissed well.

Case II. Admitted 2nd day of illness, acutely ill, with pus and albumen in the urine. Temperature normal 5th day. Urine clear 14th day. Patient dismissed well.

Case III. Admitted with Scarlet Fever and Diphtheria. Pus and Albumen on 7th day. Temperature normal, 12th day. Urine clear 50th day. Dismissed well.

Case IV. Admitted first day of illness, pus and albumen present on admission.

Temperature normal 4th day. Urine clear 9th day. Dismissed well.

Case V. Admitted second day of illness. Temperature normal on 3rd day. Rise in temperature 37th day. Temperature 103° on 40th day. Pus and albumen 41st day. Temperature settled 44th day. Urine clear 52nd day. Dismissed well.

Case VI. Admitted 2nd day of illness. Temperature normal 5th day. Pus and Albumen 30th day, no rise in temperature. Urine clear 39th day. Patient dismissed well.

Case VII. Admitted 2nd day of illness, pus and albumen present. Temperature normal 4th day. Urine clear 11th day. Dismissed well.

Case VIII./

Case VIII. Admitted 3rd day. Primary pyrexia subsided on 5th day. Rise in temperature 29th day. Pus and albumen 32nd day. Temperature normal 38th day. Urine clear 60th day. Dismissed well.

Case IX. Admitted 3rd day, very mild case. Adenitis 23rd day, no temperature. Temperature elevated 37th day. Pus and albumen 47th day. Urine clear 69th day. Patient dismissed well.

Case X. Admitted acutely ill, profuse nasal discharge. Otorrhea 13th day. Albumen 15th day. Pus albumen and adenitis 21st day. Urine clear and adenitis subsiding 31st day. Temperature normal 33rd day. Patient dismissed well.

Case XI. Admitted 4th day of illness, temperature normal 10th day. Pus and albumen 51st day. Temperature elevated on 55th day . Temperature again normal urine clear 20th day. Dismissed well.

Case XII. Admitted with diphtheria, rhinitis and adenitis. Developed Scarlet Fever 5 days after admission. Albumen present on 6th day and persisted five days.

Temperature normal 14th day. Pus and albumen 31st day. Temperature elevated 33rd day. Temperature normal 59th day. Urine clear 63rd day. Dismissed well.

Case XIII. Admitted 3rd day of illness, albumen present on admission lasting two days. Temperature normal 5th day. Albumen 13th day. Temperature elevated,pus and albumen 21st day. Temperature settled 31st day. Patient dismissed apparently well, pus/

pus and slight trace of albumen still present in the urine.

Case XIV. Admitted with Diphtheria, pus and albumen in the urine. The latter condition had existed for the past six months. Temperature practically afebrile during whole of stay in hospital. Developed Scarlet Fever three weeks after admission. Dismissed apparently well, pus and albumen still present in urine. Diet and posture did not seem to have any effect in the two last cases. Amount of pus and albumen in urine varied very much from day to day. No excess of globuline was found in either urine.

Case XII shows deficient excretion of urinary urea in the first hour. No urine was obtainable during the second hour and and urea concentration is barely normal during the third hour. Blood urea is fairly normal and U.C.F. not too low. There were casts in the urine, which is suggestive of renal mischief, although casts per se do not mean nephritis or renal inefficiency. The combination of low urea output and presence of casts in the present case, are in favour of a diagnosis of Renal Inefficiency. In the preceding 14 cases, all but XII show a normal urea concentration in the second hour. Eleven show normal excretion in the first hour and eleven in the third hour (Table G).

Blood urea is high and U.C.F. low in the first four cases, but Primary Pyrexia had not subsided and duration of illness did not exceed a week. There is no evidence of renal inefficiency except/

except perhaps in XII, most cases cleared up rapidly under treatment.

Five of the patients had coliform bacilli in the urine, as well as pus and albumen. One only had casts.

All but two cases were clear of pus and albumen on dismissal.

Conclusions.

In the preceding series of cases, Pyuria is apparently more common in girls than in boys and occurs chiefly in children under seven.

Pyuria is not an uncommon complication in Scarlet Fever, 20 per cent. of the cases recorded in this paper were Pyurias.

The majority of the patients developed Pyuria after admission and suffered from complications such as adenitis, rhinitis and otorrhea, along with the Pyuria.

Kidney functions do not seem to be impaired even in long standing cases of pyuria.

TABLE G.

No.	Age	Sex	Day of illness on wh. urine was examined	Blood press.	Protein	Percentage of urea and c.c. of urine				Blood urea	U.C.F.	Microscopic examination
						24 hours	1st. hour	2nd. hour	3rd. hour			
1	9	F	5	120/80	+	1.20-516	2.20-168	2.25-154	2.50-113	109	20	Few pus cells Coliform bacilli +++
2	7	F	5	95/60	+		2.85-55	2.48-60	3.40-70	116	22	Pus cells ++
3	7	F	7	80/65	+		2.20-28	2.65-56	1.75-85	114	23	Pus cells ++
4	3½	F	3	95/65	+	2.30-568	2.60-56	2.40-70	2.65-65	108	23	Pus cells + Epithetical cells.
5	10	F	53	95/70	+	1.30-70	2.35-76	2.15-56	1.65-67	64	25	Pus cells + Coliform bacilli +
6	7	F	36	110/75	+	1.02-908	1.12-42	2.22-42	2.00-42	82	27	Pus cells +
7	8	F	6	98/60	+	2.93-1130	2.35-40	2.75-56	2.85-56	98	28	Pus cells + Coliform bacilli +++
8	5½	F	38	86/60	++	1.45-662	2.40-60	3.10-50	2.75-60	97	31	Pus cells,
9	11	M	50	108/70	++	1.73-448	2.85-28	2.27-113	2.75-84	76	36	Pus cells +++
10	7	M	30	95/60	+	0.25-1095	1.85-83	2.25-43	1.95-113	60	37	Pus cells + Coliform bacilli +++
11	11	F	53	85/60	+	0.93-582	2.05-42	2.08-42	2.83-42	56	37	Pus cells + Coliform bacilli +
12	4½	M	38	105/75	+	1.40-560	1.50-28		2.05-168	45	44	Pus cells + Hyaline casts,
13	11	F	22	110/75	++	1.37-620	2.17-45	3.15-48	3.13-45	68	48	Pus cells,
14	3	F	63	100/75	++	1.70-255	2.25-28	2.35-69	2.15-99			Pus cells. Epithetical cells.

Group VI. Pyurias.

Summary and Conclusions.

The conclusions arrived at, after examining the urines in 80 cases of children suffering from Scarlet Fever, were as follows:-

The kidneys are efficient in cases of Scarlet Fever, in which the urine shows no abnormalities.

Cases in which the urea concentration in the urine was 2 per cent. and over during the first week of illness, often showed a high blood urea, although there was no evidence of renal inefficiency. This was most marked in cases with pyrexia.

The urea concentration in the urine, in cases of albuminuria without casts, was found to be normal, i.e. 2 per cent. and over, in:-

(1) Initial Albuminurias.

(2) Albuminurias occurring before the third week.

(3) Transient albuminurias of short duration.

The urea concentration in the urine in cases of albuminuria without casts, was found to be abnormal, i.e. under 2 per cent in:-

(1) Albuminurias occurring during the third week of illness.

(2) Albuminurias initial or otherwise persisting over a fortnight.

(3) Albuminurias with clinical symptoms of nephritis.

Neither albuminurias nor amount of albumen bear any relation to the severity of the disease and offer no indication as to prognosis.

Urea excretion in the urine was below 2 per cent. in every case in which blood albumen and casts were found in the urine.

The microscopic and chemical findings in the urine per se, offer no indication as to the efficiency of the kidneys.

The abnormal urines found in 70 cases of children suffering from Scarlet Fever, gave the following results, after a 15 grammes dose of urea:-

50/

50 per cent. excreted over 2 per cent. of urea in the urine.

50 per cent. showed defective urea excretion.

89.7 per cent. made complete recoveries.

8.5 per cent. were dismissed with albumen in the urine.

2.8 per cent. died.

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20 per cent. of cases were Pyurias.

About 37 " " " " " Albuminurias with no casts.

" 11 " " " " " Albuminurias with casts.

21 " " " " " Albuminurias, Haematurias with casts.

7 " " " " " Haematurias and Albuminurias with no casts.

The observations and clinical findings in 80 cases of Scarlet Fever in children correlated with the results obtained in estimating the urea concentration in the urine, blood urea, and urea concentration Factor, coincide on the whole with the opinions of most authorities regarding the renal condition in Scarlet Fever.

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