2. The Nonne-Apelt test is of no significance in blood-stained specimens of C.S.F. where the red cell count exceeds 10,000 per c.mm.

3. The correct protein level of a blood-stained C.S.F. can be calculated by the application of the given formula.

4. The chloride and sugar contents of blood-stained C.S.F. are not significantly affected.

5. Opinion varies as to the value of cytological study of blood-stained C.S.F.

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BLOOD CHEMISTRY, URINE ANALYSIS AND HÆMOCYTOLOGY IN ACUTE FEBRILE INFECTIONS

By V. N. MITTAL, M.D.
and
M. G. CHAKRAVARTI, D.I.C., M.SC., PH.D. (Lond.), F.R.I.C.
S. N. Medical College, Agra

Introduction

DURING the febrile stages of most acute infections both the total and the nitrogen metabolisms are found to be considerably altered. These, under ordinary conditions of feeding, usually result in negative nitrogen balances and a breakdown of proteins attributed to the combined effect of increased calorie expenditure and to the destruction of the tissues. The 'toxic destruction of proteins' appears to parallel the intensity of the injury and the severity of the infection.

Earlier work on this subject has been reviewed by Huppert, Voit and Senator. The researches were directed to the study : (1) Of urine nitrogen output in fevers. Increased output has been reported in cases of malaria by Jochmann and Tranbe; in typhoid and acute rheumatism by Huppert, Brattler and others. (2) Of total and fractional proteins both clinically and with animals. Experiments were conducted by Langstein and Meyer, Moll and Pfeiffer. (3) Of N.P.N. and urea both in the blood and urine by different workers. The present trend in research has clearly demonstrated that nitrogen metabolism during the febrile process shows marked irregularity. Sidney Ringer and Senator in their studies of malaria have shown that even when the rise of temperature is cut short by quinine the increased destruction of proteins still runs a typical course. A perfectly regular diminution of nitrogen output is by no means always the rule. A striking exception has been met with in the well-known 'epicritical elimination of urea'. Extensive studies have been made of urea, N.P.N. and creatinine fractions of the urine and blood in fevers. Creatinine in increased amounts in the urine of patients in febrile conditions has been reported by Hoffmann and Moritz.

Investigations have been made on 40 different cases of common acute febrile infections admitted in the medical ward of the S. N. Hospital in 1948-49. The following patients have been studied :

1. Upper respiratory infections.—(*a*) Acute bronchitis—3 cases, (*b*) acute tonsillitis—2 cases, and (*c*) acute pharyngitis—1 case.

2. Malaria.—(*a*) B.T. infection—5 cases and (*b*) M.T. (cerebral)—3 cases.

3. Pneumonia.—8 cases.

4. Enteric group.—(*a*) Typhoid fever—4 cases and (*b*) paratyphoid fever—4 cases.

5. Intracranial infection.—(*a*) Encephalitis—2 cases and (*b*) meningitis—3 cases.

6. Miscellaneous.—(*a*) Acute arthritis—3 cases and (*b*) infective endocarditis—2 cases.

Toxæmia has been graded as +, ++ and +++, meaning mild, moderate and severe, and attempts have been made to correlate the laboratory findings with these.

The laboratory investigations taken up in each case consist of (*i*) complete hæmocytological examinations, (*ii*) blood chemistry—protein, total and fractional urea, creatinine—and (*iii*) urine analysis, urine creatinine and urea clearance, apart from the microscopic, bacteriological or serological tests where necessary.

Methods

Hæmocytology and van Slyke urea clearance tests were made by standard techniques. Total and fractional protein, blood urea and blood creatinine were estimated by the micro methods (King) and urine creatinine by the micro method (King).

As a preliminary to these investigations, because data for the normal physiological variations of the proposed laboratory work in this province were not available, 75 normal persons were taken. Tables I and II give the laboratory findings of the studies made in the normal cases and in acute febrile infections.

Discussion

Upper respiratory tract infections.—An analysis of the cases of the upper respiratory tract infections shows low red cell count and hæmoglobin percentage. Both show further proportionate lowering in prolonged cases.

TABLE I

Normal values and range of variation of hæmocytological and N-constituents

Name of investigation	Normal range	Average	Average in males	Average in females
R.B.C. count, mill./c.mm. ..	3.89–6.10	5.04	5.21	4.79
Hæmoglobin, g. per cent ..	11.5–16.5	14.24	15.11	13.07
P.C.V., c.mm.	33–49	40.38	42.29	38.68
E.S.R., mm.	1–18	7.33	5.49	9.80
Plasma protein				
(*a*) Albumin, g. per cent ..	3.01–4.81	3.77	3.86	3.69
(*b*) Globulin, g. per cent ..	1.59–3.30	2.27	2.30	2.23
(*c*) Fibrinogen, g. per cent ..	0.17–0.52	0.23	0.32	0.30
Blood urea, mg./100 cc. ..	17.0–39.2	29.5	28.7	32.9
Blood creatinine, mg./100 cc.	0.62–1.20	0.90	0.91	0.88
Urea clearance, per cent ..	62–120	82.0	86.3	75.7
Urine creatinine, mg./100 cc. ..	65–165	98.6	94.0	98.4

TABLE II

Hæmocytology, blood and urine N-constituents and urea clearance in acute febrile infections

Disease and week of investigation	R.B.C. count, million/c.mm.	E.S.R., mm./hr.	Blood					Urine	
			Alb., g. %	Glob., g. %	Fib., g. %	Urea mg. %	Creat., mg. %	Creat., mg. %	Urea clear., %
Diseases of upper resp. tract—									
1st	4.45	28	3.45	2.77	0.34	36.8	0.93	136	101.7
2nd	4.26	26	3.32	2.64	0.27	40.3	0.88	122	91.5
3rd	4.65	9	3.62	2.46	0.30	29.8	0.87	87	85.7
Malaria—									
1st	4.19	36	3.28	3.33	0.44	50.3	1.30	165	69.4
2nd	4.34	10	3.59	2.52	0.32	27.6	0.85	67	66.9
3rd	4.69	9	3.87	2.98	0.28	30.4	0.87	69	70.8
Pneumonia—									
1st	3.82	46	3.04	3.62	0.62	64.4	1.16	204	78.9
2nd	3.89	36	3.27	3.42	0.74	39.2	1.25	192	74.4
3rd	4.32	20	3.64	3.38	0.48	36.3	0.84	139	69.8
Encephalitis—									
1st	4.13	39	3.05	3.28	0.41	59.7	1.21	232	74.4
2nd	3.84	25	3.15	2.83	0.39	51.7	1.17	172	65.7
Typhoid—									
1st	..	..	..	..	..	..	..	..	..
2nd	4.02	40	3.31	3.41	0.22	43.5	0.91	166	78.2
3rd	3.68	42	3.21	3.47	0.18	44.9	0.89	148	92.9
4th	4.51	22	3.38	2.56	0.27	32.1	0.45	98	76.2
Arthritis—									
1st	..	..	..	..	..	..	..	..	..
2nd	4.32	33	3.61	3.06	0.41	38.2	0.55	129	100.1
3rd	4.11	48	3.08	3.08	0.34	54.3	1.16	183	58.2

Erythrocyte sedimentation rate is found increased but it could not be correlated with the increase of fibrinogen. The total protein content of the plasma is slightly increased and the normal A : G ratio is found changed. In cases of more toxic destruction this change is more pronounced. Blood creatinine values on the average are 0.92 mg./100 cc. Urea clearance test shows an improved kidney function. Urine creatinine is increased partly due to increased N-metabolism and partly to reduced urine output. Cases 1 to 6 have been re-investigated on recovery after specified periods' unaltered findings due to the prolongation of the illness.

Malaria.—R.B.C. count, Hb. per cent and P.C.V. decrease and E.S.R. rises with the toxicity of the case. It is very evident in case 11 as compared to others.

The average values of plasma proteins in the three groups of toxæmic cases are 6.83, 7.83 and 6.66 g. per cent. The slightly lower average value in toxæmic group is because of two factors which counteract the effect of dehydration—(*i*) toxic destruction of proteins and (*ii*) toxic hepatic dysfunction. Plasma albumin values in all cases is slightly lower than normal while there is an increase in the globulin and fibrinogen fractions.

Blood urea has been found to rise proportionately to the degree of toxæmia and is in all cases, before treatment, over 30 mg. per cent.

Urea clearance figures in the case of cerebral malaria have been found to be considerably below normal while in others either normal or improved values have been obtained.

Blood creatinine values ranged from 0.93 to 1.66 mg. per cent, being higher in cases of cerebral malaria than in others.

The investigations repeated on recovery show that blood chemistry approached the normal values suggesting that the changes are due to the toxæmia of the febrile infection.

Pneumonia.—In these cases with the progress of the infection there is a gradual reduction in the R.B.C., Hb. per cent and P.C.V.

Plasma protein values in more than 50 per cent of the cases are over 7.0 g. per cent, the lower values encountered in the toxæmic cases in all probability being due to hepatic dysfunction and toxic protein destruction. The A : G : F ratio in all cases is found to be altered considerably and the raised values for plasma protein are due to increase both in the globulin and fibrinogen fraction.

Blood urea and blood creatinine show a rise in proportion to the toxicity of the cases and urea clearance in more toxæmic cases is impaired.

Urinary creatinine is markedly increased in all cases, the figures ranging from 100 to 250 mg. per cent. The cases followed during convalescence showed an approximation to normal data. In cases of pneumonia there is a more pronounced rise of blood urea and of plasma fibrinogen not met with on other types of febrile infections.

Enteric group.—Erythrocyte sedimentation rate is higher in cases of typhoid fever. The total proteins, A : G ratio and fibrinogen in typhoid are 6.94 g. per cent, 3.85 : 3.43 and 0.16, and in paratyphoid fever are 6.86 g. per cent, 3.46 : 3.36 and 0.22. In cases of prolonged duration all the protein fractions are lowered, blood urea values are 38.2 to 57.0 mg./100 cc. except in case 33, a severely toxæmic case, in which it is 78.7 mg./100 cc. Blood creatinine values are normal. Urine creatinine values are high in all cases.

Intracranial infections.—Plasma protein values are low in cases of encephalitis when compared with other infections and are on the average 6.04 per cent. In cases of meningitis the average is 7.04 g. per cent. The A : G ratio is found to be altered (the ratio being 3.01 : 3.21). Both globulin and fibrinogen fractions are higher than normal. The A : G ratio is reversed further still in more toxæmic cases. Blood urea is raised in all cases. Blood creatinine values also are raised. In cases 23 and 27 there were 1.85 mg. and 1.78 mg./100 cc. respectively.

Urea clearance in severely toxæmic cases was less than 50 per cent but in moderately toxæmic cases it was about 80 per cent. In case 25 of encephalitis, investigation repeated after one week gave a rise in blood urea, decrease in the albumin fraction but increase in total protein, while urea clearance was lowered from 80.3 per cent to 71.4 per cent.

Miscellaneous group.—Toxæmia in cases of arthritis was less marked. Case 30 of infective endocarditis was severely toxæmic and expired on the 20th day of the disease. In this case E.S.R. was 64 mm. and plasma fibrinogen was 0.22, plasma proteins were below 7 g. per cent. In cases of arthritis the average value of plasma proteins was 6.62 g. per cent. The A : G ratio in arthritis cases was 3.18 : 3.04 and in endocarditis cases was 3.32 : 3.25. Fibrinogen was found raised in cases of arthritis. Blood urea and creatinine level were low in cases of arthritis but were high in cases of endocarditis. Urea clearance test revealed an impaired renal function in cases of endocarditis and in case 38 re-investigated the impairment was more pronounced. Urea clearance values on the average in cases of arthritis was 99.7 per cent. Urine creatinine was very high in both cases of endocarditis, 200 mg./100 cc. In arthritis urine creatinine was in the normal range. Re-investigations were taken up in cases 37 and 38, in the former during convalescence where the findings returned almost to normal, and in the latter because the infective process was still present. The values were still abnormal.

Conclusions

1. All infective processes lead to varying degree of anæmia. High E.S.R. values during the febrile infection does not appear to depend on the amount of plasma fibrinogen.

2. The dehydration accompanying pyrexia leads to a relative hyperproteinæmia. The lowering of plasma albumin is an indication of nutritional disturbance. Total protein values by themselves give very little indication. The A : G : F ratio should be studied in detail. Hyperproteinæmia in most cases can be attributed to a rise in the globulin fraction which is found increased in different infections.

3. In acute febrile infection, for the maintenance of normal N-balances, a high protein diet is necessary.

4. Increase of blood urea in acute febrile infections is due to an accelerated N-catabolism and does not in most cases imply a renal injury. The range of rise gives an approximate idea of the virulence of the infective process. In very toxæmic cases raised blood urea plays a major rôle in the lowered kidney function.

5. Blood creatinine values are affected to a less extent but the values of urine creatinine are high and vary proportionately with the severity of infective toxæmia.

6. Urea clearance in a number of cases is found to be improved, but in severely toxæmic cases is found to be impaired.

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ARTERIA PROFUNDA FEMORIS AND ITS VARIATIONS

By IQBAL CHAND, M.B., B.S.

and

BALBIR SINGH, P.C.M.S.

Department of Anatomy, Medical College, Amritsar

IT was observed by us in the dissection hall that arteria profunda femoris, the largest and most important branch of the femoral artery, presents a good deal of variations regarding its origin and distribution in various individuals, and this led us to the detailed study of this artery in one hundred thighs in the Anatomy Department of the Medical College, Amritsar.

The usually described course of the profunda femoris artery is that, arising from the lateral aspect of the femoral artery about 4 cm. below the inguinal ligament within the femoral triangle, the artery at first runs along the femoral artery on its lateral aspect, gradually inclining medially, reaches the medial side of the femur where at the upper border of the adductor longus it gets separated from the femoral artery by passing behind this muscle. Now it inclines laterally, coming into close relationship with the linea aspera at the back of the femur, ending at the lower one-third of the thigh in a small branch which pierces the adductor magnus and anastomoses with the muscular branches of the popliteal artery in the popliteal fossa.

As the artery runs down, it is lying in front of the iliacus, pectineus, adductor brevis and magnus muscles. Within the femoral triangle it is related anteriorly to the profunda vein and femoral vessels. At the apex of the femoral triangle it gets separated from its parent trunk by passing deep to the adductor longus.

Quain in his analysis of 430 thighs on the origin of the arteria profunda femoris gives 2.5 to 5.1 cm. from the inguinal ligament in 68 per cent of thighs and in 42.6 per cent of the thighs the distance was 2.5 to 3.8 cm.

In the present series of one hundred thighs, percentage for the same distance is somewhat higher. It was in 76 per cent of thighs that the distance was between 2.5 and 5.1 cm. The distance was 2.5 to 3.8 cm. below the inguinal ligament in 59 per cent of the cases as compared with Quain, whose figure was 42.6 per cent for the same distance as stated above.

In 16 per cent of the thighs of the present series the distance was less than 2.5 cm. (Quain's figure is 24.6 per cent for the same distance). The lowest origin of the profunda in the present series was 7.5 cm. below the inguinal ligament.

In 47 per cent of the thighs investigated, the origin of the artery was from the postero-lateral aspect of the femoral artery. The usual origin described in the textbooks is from the lateral aspect which in our series was present in only 19 per cent of the thighs.

In 2 thighs, of the same body (figure 1), the artery was arising at the inguinal ligament, from the medial aspect of the femoral artery, of nearly three-quarters the size of the parent trunk, and reached near the apex of the femoral triangle behind the femoral vessels after having crossed anteriorly to the femoral vein and then running along its medial side.