

ELECTROCARDIOGRAPHIC CHANGES IN ACUTE NEPHRITIDES IN CHILDHOOD

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Electrocardiographic changes in acute nephritis in childhood have been subject to numerous investigations by various authors. In pertinent literature however, there is no agreement of opinions insofar incidence of these changes is concerned. While some authors state that ECG changes in acute nephritis are comparatively seldom met with (A. Volovik, I. Usov, A. Strutzovskaya etc.), others establish them in a substantial percentual (R. E. Mazo, D. Shilevskaya, R. Ashman etc.). Neither is there agreement on the genetical substantiation of ECG changes in acute nephritis. Some accept that these changes are conditioned by the edematous syndrome (F. Litvak, E. Borisova) and explain the changes within the heart with the increased permeability of capillaries and concurrent interstitial edema in the myocardium in particular (G. Gizov, P. Ninova and assoc.). R. Ashman and P. Hariton associate the ECG changes to the ischemia of the myocardium, due to the rapid increase of blood pressure and heart dilatation. M. S. Vovsi, G. Blagman, B. Shirvindt make reference to coronary blood circulation disorders. C. Cipollini, P. Giorgi and A. Paci explain the ECG changes in renal affections with impaired metabolism of substances and, in particular, with the electrolytic changes. In the opinion of D. Shilveskaya, the electrocardiographic changes in nephritis reflect the dystrophic changes in the myocardium.

The discrepancy in literature reports referred to motivated us to trace the ECG changes in 75 children affected with acute nephritis, treated at the pediatric clinic of the Higher Medical Institute — Varna, over the period 1964/1965.

The ECG studies on the case material comprise children in the following age groups: from 1 to 3 years — 5 children, 4—6 years — 22, 7 to 10—32, 11 to 14—16 children. Of the total number, 39 were boys and 36 girls. Past illnesses: angina — 48 children, catarrhs of respiratory ways — 10, scarlet fever — 5, skin infections — 3 and other diseases — 4. In five children forerunning affections were not established.

According to time of admission to the clinic, the children are distributed in the following manner: up to the third day after the onset of the disease — 56 children, up to the 5th — 9 children, up to the 7th — 6 and after the 7th day — 4 children. Of the total, 64 children were affected for the first time and 11 — for the second time.

The average hospitalization term was about 30 days, with treatment consisting in Penicillin, Benzacillin, Calcium gluconicum, Sol. calcium chloratum, Rutascorbin, Vit. C, Vit. B₁ and heat applications to the lumbar region (cushion heaters, paraffin). The children were on bed regimen with diet, in the first 1—3 days, consisting in fruits and sugar and thereafter —

7a and 7th diet after Pevsner. In addition, reserpin was also included in the complex treatment of 35 children.

Depending on the severity of the clinical course and the results of para-clinical examinations, the course of acute nephritis in 21 children was considered as mild (most of them were free of subjective complaints, with moderately pronounced urinary syndrome without nitrogen retention, slightly manifested edematous syndrome, slightly pronounced hypertension or no hypertension whatsoever). The disease ran a medium heavy course in 39 children (headache, sporadic vomiting, abdominal pains, well pronounced urinary syndrome with slight nitrogen retention, manifested edematous syndrome and moderate hypertension). A severe course of the disease was observed in 15 children (strongly pronounced syndrome of kidney glomeruli impairment and elevated nitrogen retention, well pronounced cardiovascular syndrome with considerable hypertension, well manifested edematous syndrome and strongly pronounced cerebral syndrome — severe headache, vomiting motor disturbance or trance). In two children eclamptic pseudo-uremia developed with lethal outcome in one. The syndromes observed in the series of children with acute nephritis are illustrated in table 1.

In our experience the incidence of the cardiovascular syndrome in acute nephritis in childhood is rather high (89.3%), a finding which is in compliance with some literature reports (90% according to M. S. Maslov, A. V. Valentinovich, V. A. Burgasova and others), and furthermore corroborates the opinion of E. M. Tareev, M. S. Vovsi and G. F. Blagman who emphasized that in patients with acute, diffuse nephritis, along with edema and urinary syndrome, on the foreground changes of the cardiovascular system also emerge (paleness, dilated cardiac outlines, tachycardia or bradycardia, dull first sound, slight systolic tone, accentuated III sound of the aorta, increased arterial pressure, liver enlargement, ECG changes etc.).

Table 1
Syndromes Observed in Acute Nephritides in Childhood

Age years	Children observed		Renal syndrome		Cardiovascular syndrome		Edematous syndrome		Cerebral syndrome	
	number	%	number	%	number	%	number	%	number	%
1—3	5	6.7	5	100	4	80	3	60	2	40
4—6	22	29.3	22	100	19	88.6	18	81.8	10	45.5
7—10	32	42.7	32	100	29	90.6	22	68.8	15	46.9
11—14	16	21.3	16	100	15	93.9	11	68.7	8	50
Total	75	110	75	100	67	89.3	54	70.7	35	46.6

With the chief objective to trace up the ECG changes in the series of 75 children with nephritis reviewed, 172 electrocardiograms were performed with standard leads (1—3 electrocardiograms per child) and 48 precordial electrocardiograms. The electrocardiograms were made on single channel apparatus Cardiomat — “Seimens”, at tape rate 50 mm per second and standard acceleration — 1 Mv. The normatives for children were employed in the interpretation of the ECG as suggested by P. Mazo, E. Edelman, S. Shamsiev, R. Zuckermann and the specialized tables of Lepschkin, Michel, Albers and Urban. The results of the investigations are illustrated in table 2.

Table 2

Electrocardiographic Changes in Acute Nephritides Depending on the Age of Affected Children

Age in years	Number of children investigated	R lowering	R splitting	T lowering	High T wave	ST lowering	P alteration	QRS extension	Prolonged PQ	Prolonged QT	El. alternans	Tachycardia	Bradycardia	Arrhythmia	El. axis shift		Unchanged
															left	right	
1—3	5	1	2	2	1	—	1	1	—	4	—	1	1	—	2	—	1
4—6	22	5	4	10	2	2	3	3	1	9	2	4	6	2	6	2	3
7—10	32	7	6	15	3	2	4	3	2	21	2	9	14	3	7	2	4
11—14	16	3	3	8	3	1	3	1	—	10	—	4	5	1	3	—	2
Total	75	16	15	35	9	5	11	8	3	44	4	18	26	6	18	4	10

In the course of acute nephritis investigations in childhood, ECG changes were discovered in 86.7% of the cases which is a percentual very near to data reported in literature by M. S. Vovsi, G. Blagman, R. Mazo, R. Ash, M. Rubin, M. Rapoport and others (92—97%) and discordant with the results claimed by I. Usov and A. Strutzovskaya (40%).

According to B. F. Zelenin, N. I. Malinovskaya, R. Mazo, R. Ashman and others, the T wave alterations are among the most frequently encountered ECG changes in acute nephritis conditions. The cited authors established changes in the T wave in 48—53% of the cases. In the series reviewed a T wave change was recorded in 46 children (61.3%). In 35 patients it was reduced (Fig. 1-a), flattened (Fig. 1-b) or negative (Fig. 1-c), whereas in 9 children — high and sharp (Fig. 2-a). The changes just described were established in all age groups and forms of the disease and were chiefly manifested with the standard and left chest leads. The problem of the genesis of these changes has been discussed by a great number of investigators. The majority associate them to disturbances in the metabolic processes of the

myocardium and hypoxia which might occur in nephritis consequent to capillaritis, arteriolospasm, edema of the myocardium and hydropericardium. In the opinion of N. Gessler and P. Keller, the electrolytic disturbance too has an essential bearing on the T wave changes (high and sharp T wave in hyperkalemia; flat and dilated — in hypokalemia). In all likelihood, myocardial hypoxia and mineral metabolism disturbances equally play an important role among the various factors accounting for the T wave alteration.



Fig. 1

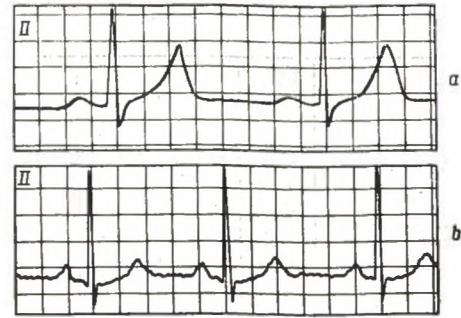


Fig. 2

In acute nephritis the ST segment depression is noted much more seldom than the T wave changes (14% according to R. E. Mazo). In compliance with data submitted by L. I. Fogelson, the ST depression is by no means characteristic of nephritis in adults. In the present series similar changes (Fig. 2-b) were established merely in five children (6.6%). Some of these changes were manifested in the left precordial leads.

Other, rather more frequently met with ECG changes, observed in acute nephritis conditions, are the changes of the R deflection. R. Mazo found out lowering of the R deflection (low voltage) in 39.1% of the children with nephritis. According to the same author, the sudden fall of the R deflection, simultaneously in all leads, is an indication for hydropericardium. I. N. Vulfson explains the lowering of the R deflection with the edematous syndrome in nephritis. In the present study, a depression of the R deflection was discovered (Fig. 3-a) in 16 children (21.3%), equally in standard and chest leads. These changes were encountered in arther heavier forms of the disease and were of longer duration — in 12 children they persisted till the end of the hospitalization period.

Another alteration of the R deflection is its splitting and indentation (in more than one lead) as an expression of slight disturbances at the level of the intraventricular conductivity. In the case material of the authors, splitting and indentation of the R deflection (Fig. 3-b) was recorded in 15 children (20%). These changes, followed up dynamically, persisted merely in six children.

More convincing evidence for disturbed intraventricular conductivity is furnished by the extension of the QRS complexes. Similar changes in acute

nephritis conditions. according to literature data, are met with in 15—25% (L. I. Fogelson, P. E. Mazo). Extension of the QRS complexes was observed by the authors of the paper in eight children or 10.7 per cent. These changes were more clearly manifested in the precordial leads and, traced up in dynamics, they regained normal values in five cases.

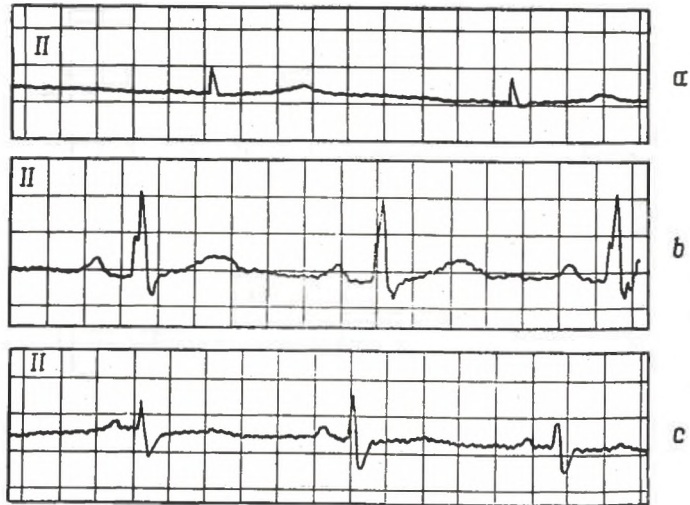


Fig. 3

Changes in the P wave (auricular complex) in acute nephritic conditions in childhood are comparatively seldom encountered (M. I. Petrenko, R. Y. Pismennyi). Depression and deformation of the P wave (Fig. 4-a) was established in 11 children (13.4%). These changes were usually transitory and merely their dynamic tracing might provide for the elucidation of their significance.

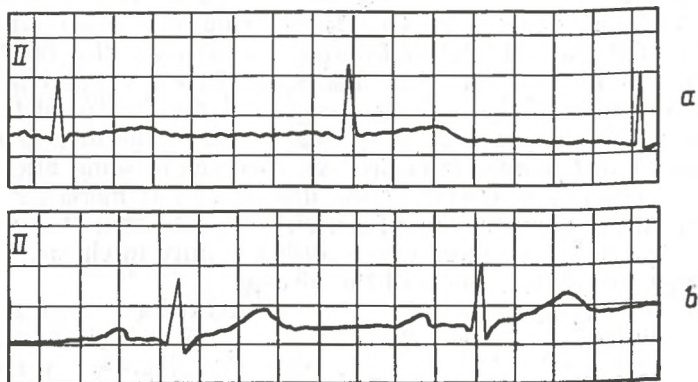


Fig. 4

Personal experience as well as literature data show that the elongation of the PQ interval (as an expression of impaired atrio-ventricular conductivity) in acute nephritis conditions in childhood is exclusively rare occurrence. Similar changes were established merely in three children (4%) with rather protracted morbid course (Fig. 4-b). According to P. E. Mazo,

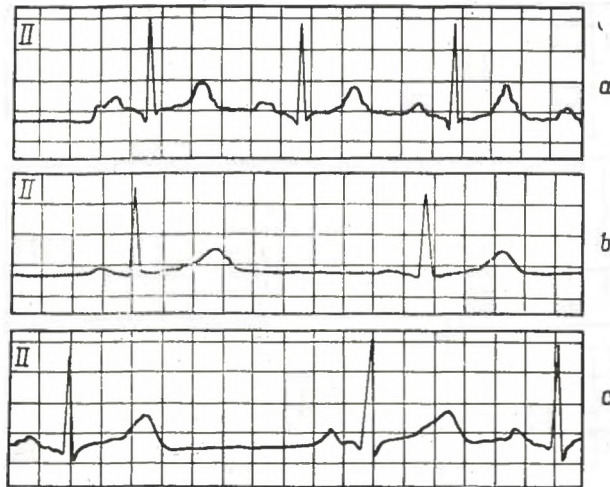


Fig. 5

he lack of prolonged PQ interval in the initial stages of the illness in the presence of lowered R deflection voltage has an essential bearing on the differential diagnosis with rheumatism.

Extrasystoles are particularly unfrequent in acute nephritis (L. I. Fogelson). Similar changes were not detected in the series under review which is in compliance with M. I. Petrenko's and R. Y. Pismenyi's statement that in acute nephritis in childhood disturbances in the excitation functions of the myocardium were never found out.

Changes in the heart rhythm were established in 44 children (58.8%), sinus tachycardia (Fig. 5-a) — in 18 (24%) and sinus bradycardia (Fig. 5-b) — in 26 children (35.3%). The latter findings approximate the data published by Mazo who claims heart rhythm changes in 53.4% of the children with acute nephritis. Most of the authors accept that the prolonged tachycardia is an unfavourable sign, indicative of heavier cardiovascular involvement. Initial transient tachycardia in nephritis is observed in some affected children running a favourable course of the disease and is moreover explained as a compensatory phenomenon of arterial hypertension. Continuous tachycardia in the series reviewed was recorded mainly in children with heavier and rather protracted course of the disease.

There is a general agreement that sinus bradycardia is typical for acute nephritis in adults (E. Tareev, M. S. Vovsi, C. F. Blagman and others). It is a rare occurrence in children's age. Sinus bradycardia was observed in 26 cases of the total number at the beginning of the disease, whilst in 9 children it appeared later. The underlying causes of the cardiac rhythm slow

down are as yet insufficiently clarified. Some authors believe that it is due to the vagus effect, whereas others find out sinus node inhibition and a certain amount of edema of the myocardium.

Sinus arrhythmia (Fig. 5-c) was established in 6 children (8%) but its role in acute nephritis of childhood is superfluous.



Fig. 6

Some authors assume the protracted relative QT-period (electric systole) as a manifestation of reduced functional capacity of the myocardium (L. Fogelson and I. Chernogorov). Whereas M. Maslov and A. Valentinovich consider the prolonged QT period as an ordinary finding in acute nephritis of childhood, R. Mazo points out that the same finding was established in 22.1% of the cases studied by him. In our material the lengthening of the QT period (Fig. 6-a) was noted in 44 children (58.6%) which, followed up in dynamics, persisted in 35 up to the end of hospitalization.

Electric alternans of the heart as an expression of myocardium contraction disorder is a rare phenomenon in acute nephritis (4.1% after Mazo). Such an alteration (Fig. 6-b) was observed in four children (5.3%) and traced in dynamics, disappeared within 15–20 days.

Arterial hypertension in acute nephritis leads to a certain amount of left heart charging and when rather substantial, it accounts for leftside deviation of the cardiac axis. A similar leftside shift of the electric axis (Fig. 7) was established in 18 children (24%) and in 12 it persisted up to the day of discharge.

Rightside shifting of the electric axis (Fig. 8) was noted in 4 children (5.3%). According to literature data (F. Zelenin, E. Samistovskaya, R. Mazo) a similar shifting of the electric axis in combination with low R deflection in the left chest leads might be assumed as a sign of right heart involvement in acute nephritis conditions.

Literature data and personal observations are indicative of an obvious interdependence between the ECG changes and the degree of arterial hyper-

tension (Table 3). The greatest number of ECG changes were established in children with rather strong arterial hypertension. It should be stressed that ECG changes were established in 14 children out of a total of 18 with normal blood pressure. This fact warrants the inference that the increased arterial pressure is by no means basic and only cause, bringing about cardiac changes in acute nephritis.

The comparative study of the ECG changes and the severeness of the course in acute nephritis conditions demonstrates that they are interde-

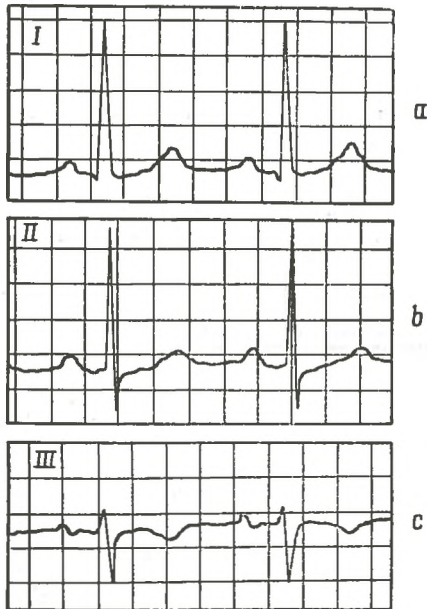


Fig. 7

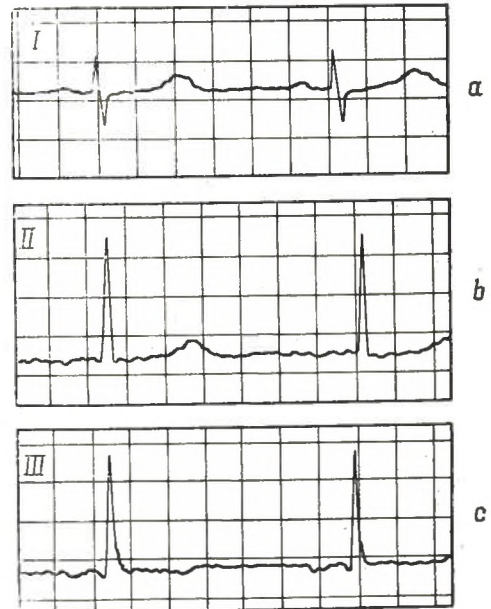


Fig. 8

pendent. Strongly pronounced ECG changes were recorded in moderate and heavy course of the disease (Table 4). Parallel to the improvement of the condition in the children, some of the ECG alterations regained normal values (39%) but the great majority persisted till the end of the hospitalization period (61%). Particularly recalcitrant appeared to be the changes in children running a severe course; they should be given special attention after the dismissal from the hospital. The pathological deviations in the electrocardiogram in acute nephritis are reversible but subside comparatively slowly. In some of the patients they disappear immediately after the subsidence of edemata and heart failure whilst in others—within 2–3 months (A. Puhlev, G. Majdrakov, B. Bratanov, N. Popov and assoc.).

In the past some of the authors largely supported the statement that in acute nephritic conditions in children, the cardiovascular system is affected much more rarely than in adults. The comparative study of the data recovered during ECG investigation of the cardiovascular system changes

Interdependence between ECG Changes and Arterial Hypertension Degree

Table 3

ECG changes	Children investigated	Considerable hypertension	Moderate hypertension	Without hypertension
Strongly pronounced	8	6	2	—
Moderately pronounced	24	8	11	5
Slightly pronounced	33	6	18	9
Without changes	10	—	6	4
Total	75	20	37	18

Interdependence between the ECG Changes and the Severeness of Acute Nephritis Course

Table 4

Course of illness	Children observed	Strongly pronounced ECG-changes	Moderately pronounced ECG-changes	Slightly pronounced ECG changes	Without ECG-changes
Mild course	21	—	6	11	4
Moderate course	39	4	12	18	5
Severe course	15	4	6	4	1
Total	75	8	24	33	10

in acute nephritis in childhood and the data reported by M. Vovsi and G. Blagman, concerning adults, demonstrate that most of the ECG changes occur with equal incidence. Hence, the cardiovascular system in children with nephritis is by no means affected more rarely than in adults.

Inference

1) On the ground of literature data and personal experience, the conclusion is reached that the cardiovascular syndrome in acute nephritis in childhood is a comparatively frequently met occurrence. Of the total number

of 75 children with acute nephritis, treated at the clinic over the period 1964/1965, cardiovascular syndrome was established in 89.3%.

2) The investigations on the ECG changes in acute nephritis in childhood revealed changes in 86.7% of the children. Some of the most frequently met changes were: T wave changes (61.3%), prolonged QT period (58.6%), changes in the R deflection (41.3 per cent), sinus bradycardia (35.3%), sinus tachycardia (24 per cent) and leftside shift of the electric axis (24%). The changes of the P wave (13.4%), QRS complex extension (10.7 per cent), sinus arrhythmia (8%), lowering of ST (6.6%) are rather more rarely met with. The cases displaying prolongation of the PQ period, electric alternans and rightside shifting of electrical axis were sporadic.

3) The ECG changes in acute nephritis in childhood are not specific and should be always considered in dynamics and correlated with clinical and paraclinical data. Traced in dynamics, some ECG changes in the series reviewed by the authors, rapidly returned to normal (39%) with disappearing of edemata, normalization of blood pressure and improvement of the general condition, whereas other persisted up to the end of their hospitalization period (61%). Particularly refractory proved to be the ECG changes among the children running rather severe course; they should receive special attention after dismissal from the hospital.

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**ОБ ЭЛЕКТРОКАРДИОГРАФИЧЕСКИХ ИЗМЕНЕНИЯХ
ПРИ ОСТРЫХ НЕФРИТАХ В ДЕТСКОМ ВОЗРАСТЕ**

Ив. Даскалов

Р Е З Ю М Е

Автор приводит собственные наблюдения над электрокардиографическими изменениями у 75 детей с острым нефритом, прослеженными динамически. Электрокардиографические изменения были установлены у 86,7% исследованных детей и они представлены в 4 таблицах и 8 фигурах.