"JOURNAL OF SCIENCE-INNOVATIVE RESEARCH IN UZBEKISTAN" JURNALI
VOLUME 2, ISSUE 9, 2024. SEPTEMBER
ResearchBib Impact Factor: 9.654/2024 ISSN 2992-8869

INTEGRAL VALUES OF ELECTROCARDIOGRAPHY IN SICK CHILDREN WITH PREMATURE VENTRICULAR EXCITATION

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Annotation

Premature ventricular excitation syndrome means that the ventricular myocardium is activated by atrial impulses conducted through accessory pathways (AP) before the impulses reach the ventricles through the normal cardiac conduction system.

Manifestations of PVS are rare - from 0.15 to 3.1% of the general population, including 9% of the total number of children with cardiac arrhythmias. This disease manifests itself in different forms - from constant clinical and electrophysiological manifestations in the manifest form to the absence of any subjective and objective symptoms in the latent form. The clinical significance of PVS is determined by the fact that almost 80.0% of patients sooner or later develop tachyarrhythmic attacks, both paroxysmal (i.e. transient) and chronic (constant - recurrent form) tachyarrhythmia, atrial fibrillation, atrial flutter, which under certain conditions are transformed into atrial and ventricular fibrillation, posing a threat to the patient's life.

Key words: arrhythmia, ventricular pre-excitation, hypertrophy, children, hearts.

Introduction. Analysis of cited literature sources shows that the frequency of PVH both among adults and children has not been established, there is no consensus

on the mechanisms of PVH development, cardiac and extracardiac factors transforming PVH into tachyarrhythmias have not been established, diagnostic errors in the interpretation of ECG - manifestations of PVH (myocardial infarction, myocarditis, congenital and acquired heart defects, mitral regurgitation, thyrotoxicosis, neurosis, syncope, etc.) are frequent [3]. Despite the advances achieved in the study of electrophysiological features of the AP, in the pathogenesis of arrhythmias in them [4], the action of antiarrhythmic drugs, indications and tactics of surgical treatment of PVH, the identification of reliable diagnostic criteria that allow timely recognition of life-threatening arrhythmias in these patients remains relevant [5]. Despite the numerous methods proposed in the diagnosis of PVH, ECG research has remained until recently the only method that allows for the topical diagnosis of PVH in children with PVH.

The purpose of the study. To study and provide general clinical characteristics of sick children with various forms of PVH in school-age children in terms of additional diagnostic capabilities of electrocardiography.

In clinical electrocardiology, the search for informative signs reflecting the activity of ventricular de- and repolarization processes continues to this day. In this regard, in age-specific electrocardiology, the study of planimetric parameters of the ventricular complex, the development of integral values (axonometric parameters) of de- and repolarization processes is more promising. Table 4.15 - 4.16 presents the ECG features of the ventricular QRS complex teeth in healthy and sick children with PVH in the age periods of 7 - 10 years and 11 - 14 years.

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Таблица 4.15

Амплитудные показатели и некоторых соотношений зубцов желудочкового комплекса ЭКГ здоровых и больных детей с ПВЖ в возрасте 7-10 лет (M±m)

№	Показатели	Контрольная группа n=50	Синдром WPW n=4	Феномен WPW n=7	Синдром CLC n=9	Феномен CLC n=11	Феномен Махайма n=4
1	RI, мм	7,63±0,25	7,75±1,42	6,17±0,53	5,66±0,59	6,30±0,45	5,00±0,84
2	RIII, мм	8,55±0,14	6,25±1,12	6,83±0,74	9,57±1,19	9,30±0,08*	6,50±1,96*
3	SI	-3,28±0,045	-0,25±0,07	-1,0±0,52	-1,0±0,12	-0,60±0,44	-1,50±0,28
4	SIII	-2,72±0,03	-3,0±1,13*	-0,75±0,18	-0,33±0,14	-0,20±0,11	-0,50±0,56
5	RV I	6,1±0,11	5,0±0,42	3,33±0,71	2,67±0,36	4,40±0,42	2,50±0,51
6	SV I	-9,6±0,18	-4,0±1,03	-0,66±0,47	-7,66±0,27	-8,40±1,31*	-0,50±0,33
7	RV 6	14,7±0,32	14,3±1,96*	14,2±1,94*	14,1±0,59*	13,8±1,19*	14,8±1,92*
8	SV 6	-3,26±0,05	-1,5±0,46	-1,33±0,23	-0,67±0,29	-0,80±0,22	-1,75±0,28
9	TV I	-0,32±0,03	-2,75±0,66	-0,67±0,18	-1,33±0,13	-1,50±0,32	-2,75±0,7
10	TV 6	3,56±0,09	2,75±0,66*	5,27±0,71	3,33±0,48*	2,90±0,44*	5,50±0,84
11	RV 6+SV1	24,2±,033	10,3±1,18	14,3±1,94	20,2±2,38*	22,2±1,96*	14,8±1,68
12	RV 1+SV6	9,65±0,39	6,5±1,68*	3,0±0,35	3,67±0,36	4,80±0,43	4,30±1,12
13	RV 6+SV1 RV 1+SV6	2,53±0,16	1,5±0,22	1,13±0,22	3,49±0,33	6,37±0,35	2,28±0,14*
14	RI/S1	-2,32±0,08	-3,26±0,88	-1,0±0,19	-1,94±0,12	-2,06±0,34	-1,30±0,18
15	RIII/S1II	-3,14±0,13	-4,34±0,49	-1,68±0,54	-1,62±0,48	-1,20±0,11	-1,00±0,06
16	RVI/SV1	-0,64±0,09	-1,0±0,24	-0,35±0,10	-0,36±0,06	-0,70±0,06	-1,30±0,16
17	RV6/SV6	-4,51±0,14	-0,66±0,08	-1,79±0,72	-5,83±0,70*	-3,65±0,87	-2,80±0,14
18	RVI/RV6	0,41±0,02	0,40±0,14*	0,22±0,04	0,25±0,02	0,33±0,05	0,16±0,08
19	(TV1)-(TV6)	3,23±0,08	0,51±0,11	2,33±0,88*	2,06±0,65*	1,20±0,33	2,75±0,12
20	(RV1)-(TV1)	5,78±0,18	1,75±0,52	1,33±0,33	1,33±0,42	2,60±0,32	3,00±0,15
21	RII	12,3±0,23	9,5±1,45*	8,,83±1,06	13,8±1,55*	15,0±2,39*	9,00±1,12
22	TII	3,1±0,07	2,25±0,28	3,0±0,35*	2,67±1,36*	2,40±0,11	3,75±0,84*
23	RII/TII	4,01±0,13	4,38±0,71	3,11±0,31	5,54±0,39	5,33±0,76*	2,60±0,47

Note: *Data except those marked with an asterisk (*) P>0.05, in all cases statistically significant (p<0.05-0.001) compared to healthy children.*

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Таблица 4.16

Амплитудные показатели и некоторых соотношений зубцов желудочкового комплекса ЭКГ здоровых и больных детей с ПВЖ в возрасте 11-14 лет (M±m)

№	Показатели	Контрольная группа n=50	Синдром WPW n=5	Феномен WPW n=10	Синдром CLC n=15	Феномен CLC n=9	Феномен Махайма n=8
1	RI, мм	5,81±0,16	9,4±1,96*	5,5±0,64*	5,2±0,62	5,28±0,45	4,57±0,60
2	RIII, мм	7,2±0,16**	1,2±0,28	5,3±0,54	7,53±0,69*	8,71±1,21*	3,57±0,47
3	SI	-2,12'±0,04	-0,20'±0,07	-1,83±0,11*	-1,2±0,15	-0,43±0,15	-0,14±0,11
4	SIII	-1,6±0,04	-6,2±0,84	-0,4±0,11	-2,4±0,16	-0,71±0,3	-1,43±0,30*
5	RV I	3,84±0,08	4,4±1,12*	3,8±0,64*	4,8±0,66*	6,43±0,60	2,86±0,76*
6	SV I	-8,23±0,14	-3,0±0,67	-4,8±0,43	-7,4±0,46*	-6,14±1,06	-4,57±0,60
7	RV 6	14,0±0,22**	15,2±1,96*	10,6±0,87	12,0±0,61	12,1±1,51*	11,9±0,76
8	SV 6	-3,78±0,06	-1,0±0,56	-1,5±0,43	-1,25±0,08	1,0±0,3	-0,29±0,09
9	TV I	-0,46±0,03	1,6±0,12	-0,55±0,21*	-0,36±0,12	-0,14±0,03	-2,57±0,30
10	TV 6	3,61±0,07**	3,2±1,01*	4,0±0,54*	2,8±0,23	3,71±0,60*	4,71±0,45
11	RV 6+SV1	22,2±0,35	18,2±1,96*	16,9±1,52	19,7±1,08*	18,0±1,06	16,9±0,91
12	RV 1+SV6	7,58±0,13	5,4±0,84	6,2±0,86	5,47±0,61	7,43±0,60*	4,0±0,76
13	RV 6+SV1 RV 1+SV6	2,94±0,08	2,51±0,77*	3,52±0,36*	4,31±0,29	2,49±0,35*	2,14±0,85*
14	RI/S1	-2,74±0,04	-0,4±0,56	-1,85±0,27	-1,15±0,21	-2,29±0,45*	-0,59±0,38
15	RIII/S1II	-4,49±0,17	-0,314±0,12	-0,95±0,22	-3,6±0,31*	-3,86±1,21*	-1,76±0,45
16	RVI/SV1	-0,47±0,01	-1,39±0,84	-0,29±0,04	-0,66±0,03	-1,51±0,23	-1,19±0,16
17	RV6/SV6	-3,68±0,08	-3,6±0,69*	-5,52±0,56	-4,06±0,5*	-12,1±2,12	-3,0±0,76*
18	RVI/RV6	0,28±0,009	0,27±0,04*	0,48±0,02	0,42±0,09	0,50±0,09	0,25±0,03*
19	(TV1)-(TV6)	3,15±0,11**	2,4±0,12	2,35±0,43*	1,8±0,26	2,48±0,45	2,14±0,42
20	(RV1)-(TV1)	3,38±0,09	3,60±0,34*	1,15±0,21	3,8±0,81*	5,14±0,30	3,54±0,35*
21	RII	1,01±0,25	8,25±1,43	7,4±0,86	11,1±0,58*	13,7±1,36	6,57±0,61
22	TII	2,94±0,09**	3,5±0,22	3,2±0,22*	2,6±0,15*	3,57±0,45*	3,29±,0,30*
23	RII/TII	3,44±0,11	3,18±0,53*	2,65±0,16	4,72±0,25	4,13±0,18	2,04±0,13

Note: *Data except those marked with an asterisk (*) P>0.05, in all cases statistically significant (p<0.05-0.001) compared to healthy children.*

The data from these tables show that the height of individual teeth of the ventricular QRS complex changes with age in healthy children. The Q tooth in this complex is rare among healthy children aged 7–10 years, and its greatest amplitude is found in standard lead III and in lead AVR. Its depth does not exceed 1.5 mm and averages 0.8±0.03 mm in children aged 7–10 years and 1.2±0.04 mm (p>0.05) at the age of 11–14 years. The duration of this tooth averaged 0.025±0.001 and 0.034 sec (p<0.001), respectively. The amplitude of the R tooth in children decreased with age in standard leads I and increased in standard leads III (p<0.001), which indicates a normal and semi-vertical position of the EOS in the frontal plane. The equations RII>RI>RIII are preserved in children aged 7–10 and 11–14 years. In standard leads

I and III, the amplitude of the S wave also decreased ($p<0.001$), and in this regard, the RI/SI and RIII /SIII values decreased with age ($p<0.001$). It should be noted that our data obtained in healthy children for the amplitude of the R and S waves in these age periods are higher than those given in the literature [76] for R and S (4.23 and 1.17 mm), respectively, obtained in healthy schoolchildren. Our data also differed in the amplitude of the R and S waves in the chest leads. The subjects had higher values of RV1, RV6 and SV1 and SV6; they had less dynamics of changes with age, especially in the value of RV6 ($p>0.05$). These features of the amplitudes of the R and S waves in our children can be explained by a wider chest perimeter and a lower content of subcutaneous fat in it. As shown in Tables 4.15 - 4.16, in healthy children, the amplitude of the RV1 wave ($p < 0.001$) and the RV1 / RV6 ratio significantly decrease with age; respectively, in the age periods of 7 - 10 years (0.415) to 0.276 ($p < 0.001$) in the period of 11 - 14 years. These data indicate an age-related increase in the mass of the left ventricle. The decrease in the amplitude of the S wave in leads V1 and V6 with age has less dynamics than the R wave, but the data are highly reliable ($p < 0.001$): SV1 decreases with age, and SV6 increases ($p < 0.001$). It is known that the sum of the amplitudes of the RV6+SV1 and RV1+SV6 teeth and their ratios are important diagnostic criteria for left and right ventricular hypertrophy. As can be seen from the data in Tables 4.15–4.16, our children differ (15.41 mm) from the data of M.B. Kuberger [76] in the sum of the RV6+SV1 teeth at the age of 7–10 (9.65±0.31) and 11–14 (7.58±0.13) years, respectively, than the data (6.01) of M.B. Kuberger [76]. The RV6+SV1/RV1+SV6 ratio in our children averaged (2.53±0.16) and (2.94±0.08) at the age of 7–10 years, i.e. the normal gradation of this indicator is more extensive at the age of 11–14 years than those reported in the literature [2, 56]. The amplitude of the T wave in the II standard lead averaged 3.1±0.07 mm in children aged 7–10 years and 2.94±0.09 in children aged 11–14 years ($p>0.05$). Its ratio with the R wave (RII/TII) decreased with age (4.01±0.13 and 3.44±0.11, $p<0.001$). The T wave in lead V1 is positive in most cases 47.0%, the frequency of negative T waves in VI is higher at the age of 11-14 years (58.0%) than at the age of 7-10 years (36.0% $p<0.05$). The negative TV1 wave at the age of 7-10 years (–0.32±0.03) becomes more pronounced with age (–0.46±0.03 mm, $p<0.001$). The RV6/TV6 ratio in our children averaged 4.12±0.016 and 3.87±0.02 ($p<0.001$), respectively, in the age periods of 7-10 years and 11-14 years. In the pediatric clinic, these changes are not given due importance. In this regard,

we were the first in a pediatric clinic to use the ECG syndrome of ventricular repolarization □(TV1) – TV6)□ in their hypertrophy (Dolobchyan Z.L., 1973).

In case of left ventricular hypertrophy, the syndrome □(TV1) – TV6)□ decreases, i.e. deepens towards the negative value, and in case of right ventricular hypertrophy, there is an increase towards positive signs.

In sick children with manifestations of WPW (Table 4.15 - 4.16), the amplitude of the R waves in I, II, III standard leads is reduced in most cases ($p < 0.05 - 0.01$) compared to healthy children, these data are more pronounced in primary school age ($p < 0.01 - 0.001$). In sick children with WPW syndrome aged 7 - 10 years, the RI / SI and RIII / SIII ratio is increased, indicating an increase in left ventricular activation. In sick children, the amplitude of the Rv1 wave decreases ($p < 0.05 - 0.01$) with an unchanged Rv6 value ($p > 0.05$). These data in combination with a decrease in the SVI amplitude in sick children may also indicate an increase in left ventricular activation. However, the amplitude of the S wave also decreased in the left precordial leads (V6). These changes are most pronounced in children with the syndrome (–0.67 ± 0.29) and the CLC phenomenon (–0.8 ± 0.22) aged 7–10 years and in children with the Mahaim phenomenon (–0.29 ± 0.09) aged 11–14 years. The RV1/SV1 ratio in children with the syndrome, as well as in healthy children, had a value of <1.0. In our opinion, such an RV1/SV1 ratio (> 1.0) also occurs with right bundle branch block. A true increase in the RV1/RV6 ratio due to an increase in the R voltage in V1 was observed only in children with the CLC phenomenon aged 11–14 years, indicating right ventricular hypertrophy.

Thus, in children with the syndrome, ECG mainly showed increases in the electrical activity of the right and left ventricles. Apparently, unlike adults, in childhood, the electrophysiological factor takes a more important place in ECG examinations - the summation of two oppositely acting vectors (left ventricular, right ventricular) of the electromotive force of the heart due to the positional factor of the heart in the chest. A large deviation of the maximum QRS vector to the left or right due to pronounced cases of hypertrophy of the right and left ventricles observed in adults, apparently occurs later due to constantly acting hemodynamic factors, which leads to anatomical shifts, and represents the genesis of the high RV1 and RV6 teeth, reflecting the thickness of the myocardium of the right and left ventricles.

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