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The Prognostic Significance of the QRS Amplitudes of Electrocardiogram in Kwashiorkor

MT OLOWONYO[+] OO OGUNKUNLE[++] FO AKINBAMI[+++] AND F JAIYESIMI[++++]

Summary

Olowonyo MT, Ogunkunle OO, Akinbami FO and Jaiyesimi F. The Prognostic Significance of the QRS Amplitudes of the Electrocardiogram in Kwashiorkor. *Nigerian Journal of Paediatrics* **1993; 20:13.** Electrocardiograms (ECGs) were performed on 52 children with kwashiorkor and 52 age-and sex-matched controls. Heart rates were higher ($p<0.05$) and QTc intervals longer ($p<0.05$) in patients with kwashiorkor than in the controls. The QRS amplitude in all the leads in patients with kwashiorkor was smaller ($p<0.05$) than those of the controls. The QRS amplitudes in the survivors were significantly wider ($p<0.05$) than in those of the patients who died. Average QRS amplitude of less than 5mm in the standard limb leads and less than 10mm in the chest leads indicated poor prognosis.

Introduction

KWASHIORKOR is still a common preventable nutritional disorder associated with high morbidity and mortality among Nigerian children.[1] Various factors have been incriminated as the cause of death in this condition.[2-5] Although many workers[6,7] have reported the rarity of clinical evidence of cardiac involvement in kwashiorkor, sudden death which occurs in some cases, has been attributed to myocardial dysfunction.[8] While South African workers[6,9] have observed a significant association between the QRS amplitude in the electrocardiogram (ECG) and prognosis in kwashiorkor, no such study, to the best of our knowledge, has ever been undertaken in Nigeria. Since sudden death of children with kwashiorkor is a common experience here in Nigeria, especially during the convalescent stage,[10] any measures that would reduce the mortality from kwashiorkor will be most desirable. This paper presents the results of our recent study on the prognostic significance of QRS amplitudes in children with kwashiorkor.

Iya Subomi Child Care Centre, Ijebu-Ode

[+] Consultant Paediatrician

University College Hospital, Ibadan

Department of Paediatrics

[++] Lecturer

[+++] Senior Lecturer

[++++] Professor

Correspondence: MT Olowonyo

Patients and Methods

Children with kwashiorkor, as defined by Wellcome Trust[11] and aged between one and four years, admitted into the department of paediatrics, University College Hospital (UCH), Ibadan, over a period of 18 months (January, 1989 to June, 1990), were studied. Those with

pre-existing cardiovascular disease, or sickle-cell anaemia were excluded. Apparently healthy children, aged between one and four years, served as controls. After obtaining parental verbal consent, each patient was carefully examined with particular emphasis on the cardiovascular and respiratory systems. A 12-lead electrocardiogram was obtained for each patient on admission, using Marquettee Electronics Inc 3-channel ECG machine. Measurements of the heart rate, rhythm, PR interval, QTc value, QRS duration and QRS axis were taken, using internationally accepted recommendation.[12] QRS amplitude was measured from the top of the R-wave to the bottom of S-wave.[13] Student's t-test was used to assess the statistical significance of observed differences.

Results

There were 52 patients (29 males, 56 percent and 23 females, 44 percent; male: female ratio = 1.3 : 1) and 52 controls (24 males, 46 percent and 28 females, 54 percent; male : female ratio = 0.9 : 1). The mean age of the patients was 1.99 ± 0.86 years with 45 (86 percent) of them, aged between one and three years. There were 29 deaths (a case mortality rate of 55.8 percent). None of the patients had clinical evidence of heart failure. The interval between the performance of the ECG and death in those that died was between three and seven days.

Table I shows that the mean heart rate of 124 ± 21 beats per minute (range: 65-180 beats per minute) among the patients was faster ($p<0.05$) than that of the controls whose corresponding values were 93 ± 14 beats per minute (range: 75-120 beats per minute), respectively. Similarly, the mean QTc interval in patients with kwashiorkor (mean = 0.43 ± 0.034, range = 0.34 - 0.49) was longer ($p<0.05$) than the controls (mean = 0.41 ± .022, range = 0.36 - 0.44). The differences between the patients and controls, in respect of PR interval, QRS duration and Axis were not significant ($p>0.05$). The QRS amplitude (Table II) was significantly smaller ($p<0.05$) in all the leads in patients with kwashiorkor when compared with controls. There was no difference ($p>0.05$) in the PP intervals, QRS duration and QRS axis between the patients and the controls. In all the leads, the mean QRS amplitude in patients who died (Table III) was significantly narrower ($p<0.05$) than the mean of those who survived. There were 11 patients whose average QRS amplitude in the limb leads was less than 5mm and of these, eight died, while three survived (a case fatality rate of 72.7 percent). The average QRS amplitude in the six chest leads was less than 10mm in only seven patients out of whom five died, a case mortality rate of 71.4 percent.

TABLE I

Mean (±SD) Heart Rate, PR intervals, QRS duration, QRS Axis and QTc intervals in Patients with Kwashiorkor and Controls

Item	*Kwashiorkor (n=52)*	*Controls (n=52)*	*P*
Heart rate/min	124 ± 21 (65 - 180)	93 ± 14 (75 - 120)	<0.001*
PR interval (seconds)	0.124 ± 0.21 (0.10 - 0.21)	0.124 ± 0.014 (0.10 - 0.16)	>0.05
QRS duration (seconds)	0.052 ± 0.01 (0.04 - 0.08)	1.052 ± 0.01 (0.04 - 0.08)	>0.05
QRS axis (degrees)	48 ± 30 (0 - 180)	41 ± 23 (-15 - 90)	>0.05
QTC intervals (seconds)	0.43 ± 0.034 (0.34 - 0.49)	0.41 ± 0.022 (0.36 - 0.44)	<0.05*

Values in parentheses represent range
SD = Standard deviation
* = Significant
n = represents number of patients and controls

TABLE II

Mean R+S Amplitudes (mm) in Patients with Kwashiorkor and Controls

Lead	Mean R+S amplitude ± SD		P
	Kwashiorkor (n=52)	Controls (n=52)	
I	6.4 ± 3.5 (2.3 - 14.6)	12.2 ± 5.3 (4.6 - 21.4)	<0.001*
II	7.5 ± 4.2 (2.3 - 19.2)	11.9 ± 3.5 (4.6 - 20.8)	<0.001*
III	5.8 ± 3.1 (1.0 - 12.0)	8.4 ± 4.0 (2.5 - 18.4)	<0.001*
AVL	4.8 ± 2.1 (0.2 - 10.8)	9.2 ± 4.2 (2.0 - 20.8)	<0.001*
AVF	6.1 ± 3.8 (1.0 - 13.8)	10.4 ± 5.1 (3.0 - 20)	<0.001*
V_1	14.4 ± 6.5 (3.3 - 41)	21.8 ± 8.0 (10.3 - 36)	<0.001*
V_2	24.2 ± 8.8 (8.8 - 46.0)	37.3 ± 10.3 (11.4 - 52.0)	<0.001*
V_4	20.5 ± 7.8 (5.0 - 34.8)	32.1 ± 7.8 (16.5 - 51.2)	<0.001*
V_5	16.5 ± 7.0 (3.2 - 39.0)	29.5 ± 5.9 (15.7 - 35.5)	<0.001*
V_6	10.8 ± 5.5 (3.52 - 22.7)	20.3 ± 6.7 (8.3 - 30.4)	<0.001*

Values in parentheses represent range

SD = Standard deviation

* = Significant

Note: Omission of AVR because of dwarfed and unmeasurable amplitudes.

TABLE III

Mean QRS Amplitudes in Survivors and dead Patients

Lead	Mean QRS amplitudes ± SD (mm)		P
	Survivors (n=23)	Dead (n=29)	
I	7.65 ± 3.17	4.01 ± 1.58	<0.005*
II	9.24 ± 1.75	4.91 ± 1.65	<0.001*
III	6.11 ± 2.64	3.68 ± 1.6	<0.005*
AVL	4.68 ± 3.02	2.54 ± 1.54	<0.005*
AVF	6.71 ± 2.28	3.5 ± 1.66	<0.001*
V_1	16.03 ± 3.95	11.37 ± 4.17	<0.005*
V_2	27.59 ± 7.21	20.61 ± 8.63	<0.05*
V_4	27.18 ± 5.33	18.73 ± 6.88	<0.001*
V_5	20.75 ± 7.75	12.69 ± 6.23	<0.005*
V_6	13.95 ± 5.17	9.08 ± 4.84	<0.01*

SD = Standard deviation

* = Significant

n = Number

Note: Omission of AVR because of dwarfed and unmeasurable amplitudes

Discussion

Poor prognostic factors in kwashiorkor that have been reported by others include infections,[3,4] hypothermia,[14] hypoglycaemia, [4,14] electrolyte distrubances, such as hypokalaemia, hyponatraemia and hypomagnasaemia.[5,14] Other poor prognostic factors are heart failure and cardiac arrhythmia.[10,15] It is noteworthy that in the present study, none of the above factors were observed in any of the patients. However, as reported by previous workers,[6] generalized low voltages were present in the ECG of our patients. An explanation for this phenomenon includes myocardial thinning, metabolic derangements, decreased metabolic rates, pericardial ef-

fusion and subcutaneous oedema.[16] The possibility of oedema is unlikely as the ECG findings reported in malnourished cases with or without oedema are not significantly different.[15]

Our present findings of significantly smaller QRS amplitudes ($p<0.05$) in patients than in the controls, are in agreement with those reported from South Africa.[6,9] While Janssen and Roux[6] showed a direct relationship between the QRS amplitude and the severity of malnutrition, Smythe, Swanepoel and Campbell[9] reported that voltage of less than one millivolt portended poor prognosis. Unverferth[16] has defined low QRS voltage as the average QRS voltage that is less than 5mm in the three standard limb leads and less than 10mm in the precordial leads. In the present study, 72.7 percent of the patients with kwashiorkor with the average QRS amplitude less than 5mm in the standard limb leads died, while 71.4 percent of those whose average QRS amplitude was less than 10mm in the chest leads also died. It may therefore, be concluded that an average QRS amplitude of less than 5mm and 10mm in the standard limb leads and chest leads, respectively, indicates bad prognosis. In view of the present findings, it is suggested that all children with kwashiorkor should undergo cardiovascular evaluation, including ECG study, so as to identify those at risk, in order to apply appropriate and prompt intervention. Restraint should be exercised in an aggressive fluid management of these patients with very low QRS amplitude, especially during the convalescent stage.

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