

HEART DISEASE SCREENING OF SCHOOL CHILDREN USING ABBREVIATED ELECTROCARDIOGRAM AND PHONOCARDIOGRAM

BY

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ABSTRACT

By recording the electrocardiogram and phonocardiogram simultaneously using three abbreviated leads, 23,216 (6 and 7 years of age) elementary school children were screened for heart diseases. One hundred and one cases (0.44%) with congenital heart diseases, ten cases (0.04%) with acquired heart diseases and 100 cases (0.43%) with electrocardiographic abnormalities were discovered. From these observations, we conclude that this screening method applied on school children is useful in discovering the previously unrecognized heart diseases, especially atrial septal defect, primary myocardial disease and arrhythmia.

INTRODUCTION

Because of the importance of finding out unrecognized but serious heart diseases in school children, various screening methods have been tried by many cardiologists. We designed a mass screening method using a machine which has the ability to obtain simultaneous tracings of electrocardiogram and phonocardiogram using abbreviated three leads.

This report describes the results of the study performed on elementary school children by this method. The advantages of this screening method are discussed.

MATERIALS AND METHODS

This study was carried out between 1975 and 1977 in two districts (Chuo-ku and Katsushika-ku) in Tokyo. Of a total of 23,513 children (6 and 7 years of age) who were in the first grade in 70 elementary public schools at the time of the evaluation,

we were able to examine 23,216 children (98.7%). Questionnaires on the history of the congenital heart disease, rheumatic fever, mucocutaneous lymph node syndrome (MCLS, Kawasaki disease) and arrhythmia were answered by the parents. The answers to the questionnaires were reviewed prior to taking the electrocardiogram (ECG) and phonocardiogram (PCG).

We used an accelerative microphone and 2-channel direct-writing electrophonocardiography which had the ability to obtain simultaneous tracings of ECG and PCG using abbreviated three leads. ECG was taken by three leads, II, V₁ and V₅. PCG was recorded at three sites, the second and fourth intercostal space at the left sternal border and the apex. Three pediatric cardiologists reviewed the ECG's, PCG's and the questionnaires. The children who were thought to have heart disease or needing further evaluation were selected. All these children were asked to come to have a more

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Received for publication, September 2, 1978.

Table 1. Type of Heart Diseases and Number of Cases Detected Among 23,216 Schoolchildren

	Previously diagnosed	Recognized by this survey	Total No.	% of all subjects
Congenital heart disease	96	5	101	0.44
Acquired heart disease	3	7	10	0.04
ECG abnormality	6	94	100	0.43
Total	105	106	211	0.91

Table 2. Types of Congenital Heart Disease

	Number
Ventricular septal defect (VSD)	50 (10)
Atrial septal defect (ASD)	19 (4)
Pulmonary stenosis (PS)	7 (3)
Tetralogy of Fallot (T/F)	6 (5)
Patent ductus arteriosus (PDA)	2 (2)
Aortic stenosis	2 (1)
VSD+PS	2 (0)
VSD+PDA	1 (1)
ASD+PDA	1 (1)
ASD+PS	1 (1)
Tricuspid stenosis	1 (0)
Endocardial cushion defect	1 (1)
Dextrocardia ¹⁾	8 (0)
Total	101 (29)

() Postoperative cases
1) Without other heart diseases

detailed examination performed.

RESULTS

One hundred and one cases with congenital heart diseases, ten with acquired heart diseases and 100 with ECG abnormalities, i. e. a total of 211 cases (0.91% of all children examined) were identified, and of these the disease was not recognized before this study in 106 cases (Table 1). Table 2 shows the types of congenital heart diseases. Twenty-nine of 101 cases with congenital heart diseases had already received corrective surgery. Five of 19 cases with atrial septal defect and 4 of 8 cases with dextrocardia were detected for the first time by this study. Of the 10 cases of acquired heart diseases four had mild mitral

Table 3. Types and Incidence of ECG Abnormality

	Number	Rate per 1,000
Second degree AV block	2	0.1
Extrasystole		
Supraventricular	10	0.4
Ventricular	37	1.6
A-V dissociation	2	0.1
WPW syndrome	10	0.4
Complete right bundle branch block	30	1.3
Shortening of PR interval (PR<0.10 second)	9	0.4
Total	100	4.3

insufficiency, 3 primary myocardial diseases and 3 cardiovascular sequelae of MCLS. Three out of 4 cases with mitral insufficiency, 2 of 3 with primary myocardial diseases and 2 of 3 cases with cardiovascular sequelae of MCLS were noticed for the first time by this screening program. Of the 3 cases with cardiovascular sequelae of MCLS, one had already received a coronary by-pass surgery and 2 were shown to have aneurysms of the coronary arteries by coronary angiography performed about 6 months after the authors' survey.

Table 3 shows the types of ECG abnormalities in 100 cases without any evidence of an organic heart disease. Thirty-four of 37 cases with ventricular extrasystole, 8 of 10 cases with WPW syndrome and all cases with a second degree A-V block, supraventricular extrasystole, complete right bundle branch block and shortening of PR interval had not been recognized before

this study.

Restriction on physical activities was indicated for 4 cases with ventricular extrasystole, in whom ventricular premature contractions were quite frequent, and for the cases with WPW syndrome associated with a history of paroxysmal atrial tachycardia. No restriction of physical activities nor medical treatment was indicated for the remaining cases with ECG abnormalities.

DISCUSSION

There have been several reports of various screening methods for heart disorders in school children utilizing ECG (Morton,^{1,2} Tsuda *et al.*,³) and Niimura *et al.*⁴), heart sound tape recording of heart sound (Miller *et al.*,⁵ Naiman and Barrow,⁶ Morton and Huhn,⁷) and Perry *et al.*⁸), and analog computer (Durnin *et al.*,⁹ Gayler and Warren,¹⁰ Henikoff, Stevens and Perry,¹¹) and Hashimoto *et al.*¹²). However, there have been a few reports on the screening of heart diseases utilizing the ECG and PCG simultaneously as in the present study (Kobayashi and Okuni¹³).

Heart diseases in school children in Japan were used to be screened as follows: at first, the school physician (usually a family physician) selected children with a possible heart disease by physical examination, reviewing the questionnaires on heart diseases and reading the chest x-ray films (70×70 mm in size), and then the pediatric cardiologist made the correct diagnosis depending on the ECG's, PCG's and full-size chest x-ray films of primarily screened children. In recent years, however, attempts are being made to discover primary myocardial diseases, arrhythmia and cardiovascular diseases due to MCLS (Kato *et al.*,¹⁴ Hosaki *et al.*¹⁵) as well as congenital heart diseases by utilizing the ECG and/or PCG during

the primary screening program. By our screening method, twice as more cases of congenital heart diseases and about five times more cases of arrhythmia were detected than by the conventional method of screening for heart diseases in school children in Japan (Takashina¹⁶). It seems that due to the simultaneous use of the ECG and PCG in all school children a better efficacy is obtained in screening than by the previous method.

Therefore, we think that this method is an excellent one for differentiating an organic heart murmur from an innocent heart murmur and for a better detection of atrial septal defect, primary myocardial disease and arrhythmia which were sometimes overlooked by the previous method.

ACKNOWLEDGEMENT

The authors wish to thank the Chuo-ku and Katsushika-ku Ward Medical Societies and the Tokyo Association of Health Service for their cooperation in this study.

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