The Incidence and Relative Frequencies
of Congenital Heart Disease
in School Children in Otsu (1960-1966)

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TOYOHIKO ONISHI‡

The incidence and relative frequencies of congenital heart disease in school children were estimated by a field investigation. All the primary and the secondary school children in Otsu, a middle city of Japan, were investigated a few consecutive years for this study. In all 26,177 children were examined, of whom 85 had congenital heart disease, giving an over-all rate of 3.2 per 1000. The most common malformation was ventricular septal defect, after which atrial septal defect and patent ductus arteriosis followed. An incidence of 3.2 per 1000 is intermediate among the previous results in these age group.

The incidence and relative frequencies of congenital heart disease depend remarkably upon various factors, of which, for example, age and sex distributions of the subjects, materials, autopsy-controlled or clinical and methods, field-investigative or clinical, are important. Above all the age distributions are the most.

Investigations in school children were reported by various authors1-6, but previous reports do not necessarily take into consideration the above mentioned variables, and also a determination of the over-all incidence of congenital heart disease would require a field investigation within a given area and within a given age distribution.

During 1960-1966, a field investigation was conducted in 26,177 school children in Otsu and 85 subjects with congenital heart disease were found.

The purposes of this paper are to estimate the number of cases and the prevalence rate of congenital heart disease.

Methods and Materials

Otsu, a middle city in Japan, is average in all respects with regard to climatic, economic and other conditions. Its population is about 120,000. In this city examination for detection of congenital heart disease has been conducted consecutively during these six years. Accordingly most cases suspected of heart disease were carefully examined a few consecutive years, at least. The age group 7 to 16 years was selected because this would include all the primary and the secondary school children and would yield the desired samples sufficient to achieve our purposes. A total of 26,177 children in this age group were all examined. We approached the study of this field investigation with two methods.

First, a questionnaire was sent to each home of the children. And cases with a total of scores of each item above a certain limit were selected. Second, we attempted to obtain information about all cases of congenital heart

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disease in school children. Therefore, each child was examined for cardiac murmurs by school medical consultants. Children believed to have definite or questionable heart disease were referred to teleroentgenography and electrocardiography, and consulting these data each case was carefully auscultated by one of us. Suspected murmurs were recorded by phonocardiograph. Cases supposed to have congenital heart disease were examined cooperatively by all of us and diagnosed conclusively, at least temporarily.

**Results**

In all 26,177 children were examined, of whom 85 had congenital heart disease, giving an over-all rate of 3.2 per 1000 examined. Cardiac catheterization and/or angiocardiography were performed in 41 cases, autopsy in only a few cases and 33 of these 41 cases were operated upon. The diagnoses are listed in Table I. "Diag. det." (diagnosis determined) operation. These 4 cases had patent ductus arteriosus, large ventricular septal defect, tetralogy of Fallot, and ventricular septal defect combined with patent ductus arteriosus, each respectively.

The most common malformation was ventricular septal defect. There were 31 cases, of whom 10 had Roger's disease. Large ventricular septal defect was present in 21 cases, part of whom are supposed to have progressed to Eisenmenger complex. After ventricular septal defect 26 cases of atrial septal defect and 14 cases of patent ductus arteriosus followed. The other malformations were rare and their numbers were below 3.

Direct inquiry with regard to contraction of German measles during the first trimester of pregnancy was made to all mothers who had children with definite congenital heart disease, but even suspected cases of this viral infection were not found in any case.

**Discussion**

As mentioned previously, the incidence and relative frequencies of congenital heart disease differ considerably because of various factors involved. About half of the infants with congenital heart disease die by the end of the first year of life\(^7\)-\(^9\). After the first year of life, at least from this time to the puberty, the number of patients who die decreases appreciably\(^7\)-\(^9\). In our experience only 4 of the 85 patients died during these 6 years. Therefore assuming that infants under the age of 1 year are studied, the incidence of congenital heart disease increases accordingly. Concerning the incidence Mac Mahon\(^7\) stated that there was 3.17 per 1000 total births and 3.23 per 1000 live births, and estimated that there was 1.1 per 1000 children at the 10th birthday. According to Carlgren\(^8\) 6.4 per 1000 live births decreases greatly to 3.9 per 1000 children during the 7-16 year period of observation. As a matter of course the total incidence, taking stillbirth babies into consideration, increases\(^7\)-\(^9\).

Thus the age specific distribution of congenital heart disease differ greatly. The mean age of our materials is 12.5 years and the incidence of congenital heart disease is 3.2 per 1000. The results are identical with those of

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**Table I**

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>No. of cases</th>
<th>Diag. det.</th>
<th>Op.</th>
</tr>
</thead>
<tbody>
<tr>
<td>PDA</td>
<td>14 (16.5%)</td>
<td>12</td>
<td>11</td>
</tr>
<tr>
<td>ASD</td>
<td>26 (29.5%)</td>
<td>10</td>
<td>8</td>
</tr>
<tr>
<td>VSD</td>
<td>31 (36.5%)</td>
<td>12</td>
<td>9</td>
</tr>
<tr>
<td>Large VSD</td>
<td>21 (24.7%)</td>
<td>11</td>
<td>8</td>
</tr>
<tr>
<td>Roger's dis.</td>
<td>10 (11.8%)</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>PS</td>
<td>2 (2.5%)</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Fallot</td>
<td>3 (3.8%)</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>ECD</td>
<td>3 (3.8%)</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>VSD+PDA</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>VSD+Transp. of great vessels</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>VSD+AI</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Undetermined</td>
<td>3 (3.8%)</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Percentages are given in parenthesis.

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INCIDENCE AND RELATIVE FREQUENCIES OF CONGENITAL HEART DISEASE

TABLE II  COMPARATIVE PREVALENCE OF HEART DISEASE IN SCHOOL POPULATION OF VARIOUS COUNTRIES

<table>
<thead>
<tr>
<th>Year</th>
<th>Author</th>
<th>Country</th>
<th>Age of sample (yr.)</th>
<th>No. examined</th>
<th>Incidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>1962</td>
<td>Miller et al.</td>
<td>U.S.A. (Chicago)</td>
<td>elementary</td>
<td>33,026</td>
<td>2.1</td>
</tr>
<tr>
<td>1959</td>
<td>Morton et al.</td>
<td>U.S.A. (Colorado)</td>
<td>6-11</td>
<td>6,311</td>
<td>5.2</td>
</tr>
<tr>
<td>1955</td>
<td>Stuckey et al.</td>
<td>Australia</td>
<td>elementary &amp; secondary</td>
<td>364</td>
<td>2.1</td>
</tr>
<tr>
<td>1966</td>
<td>Abbasi et al.</td>
<td>Pakistan (Karachi)</td>
<td>8-14</td>
<td>4,002</td>
<td>1.8</td>
</tr>
<tr>
<td>1959</td>
<td>Carlgren</td>
<td>Sweden (Gothenburg)</td>
<td>&gt;7</td>
<td>3.9*</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Present study</td>
<td>Japan (Otsu)</td>
<td>7-16</td>
<td>26,177</td>
<td>3.2</td>
</tr>
</tbody>
</table>

* Estimated by us.

CARLGREN. The prevalence rates of congenital heart disease in school children of 10 years or so reported from various parts of the world are listed in Table II. As illustrated from this table the incidence figure of ours is intermediate among the various results from the world. Also the relative frequencies of congenital heart disease depend upon the age distributions of the patients. Most infants who die within the first year of life suffer from one of the three malformations — namely transposition of the great vessels, ventricular septal defect and coarctation of the aorta. Accordingly in school children of about 10 years of age, excluding cases of ventricular septal defect, examples of coarctation of the aorta and transposition of the great vessels may be thought to be small in number.

Because the results mentioned in Table II had defects of being small in number or in these studies classification with regard to the frequencies of each congenital heart disease was not performed merely for the purpose of screening, our results should be compared with those of CARLGREN, who followed up 224 cases still alive, the period of follow-up varying between 7 and 16 years (Table III). We compared the relative frequencies with regard to congenital heart disease whose frequency was more than two. CARLGREN’s series comprised only 2 cases of the transposition of the great vessels and 5 cases of coarctation of the aorta. These two malformations were seldom encountered in his series, which verified the results of COLEMAN. Taking into account the absence of cases with these two malformations in our series, this fact suggests that these malformations contributed to the fatal outcome in cases with congenital heart disease during infancy. CARLGREN’s series comprised as many as 10 cases with aortic stenosis and a considerably small number of cases with atrial septal defect in comparison with our cases. In both series the relative frequencies of ventricular septal defect and patent ductus arteriosus are almost the same. But in regard to the frequency of atrial septal defect our series gave a rate of 29.5 per cent in comparison with only 2.7 per cent of CARLGREN’s. Concerning atrial septal defect, NADAS stated that in approximately 15 per cent of all patients who have congenital heart disease and who live through infancy, an atrial septal defect is the principal lesion. In general this view is maintained universally. The relative frequency of atrial septal defect in our series is twice that of

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Nadas’ series. In any event a noteworthy fact is that the relative frequency of atrial septal defect of Carlgren’s series is very small.

CONCLUSION

The prevalence of congenital heart disease in school children in Otsu during 1960–1966 was studied. Among a total of 26,177 children from 7 to 16 years of age we found 85 with congenital heart disease — an incidence of 3.2 per 1000. In 41 cases cardiac catheterization, angiocardiography, operation and autopsy were performed with either one or several of these methods, and the other cases were carefully examined clinically. Thus in 96 per cent of cases diagnosis was confirmed. An incidence of 3.2 per 1000 is intermediate among the previous results in these age groups. Ventricular septal defect was the most common individual malformation followed next by atrial septal defect and patent ductus arteriosus. These three malformations were observed in 82.5 per cent of the total cases. Cases with coarctation of the aorta and transposition of the great vessels were not encountered. A mortality of the children with congenital heart disease from 7 to 16 years of age was very small (4.7 per cent). This low mortality rate was in accordance with the previous results. The correlation of congenital heart disease with fetal German measles infection was denied in all cases by careful inquiry to the mothers.

Acknowledgement

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REFERENCES