Serious Congenital Heart Disease in the Neonatal Period. Frequency in a Children's Hospital

Norio MATSUO, M.D., Masahiro OSHIMA, M.D., *and*
Masuyoshi NAGANUMA, M.D.

SUMMARY

A report of 107 infants with serious congenital heart disease during the neonatal period is presented. Determination of the basic defects was made at autopsy and/or cardiac catheterization and selective cineangiocardiogram.

The most frequent congenital cardiac anomalies were coarctation of the aorta syndrome, ventricular septal defect, complete transposition of the great vessels, and hypoplastic left heart syndrome, similar to previous reports in the Occident. The incidence of endocardial cushion defect and total anomalous pulmonary venous return was higher than previous Occidental reports. The incidence of associated noncardiac anomalies with serious cardiac signs was 26.2%.

Additional Indexing Words:

Asplenia syndrome Hypoplastic left heart syndrome Prognosis
of CHD Noncardiac anomalies associated

CONGENITAL heart disease during the neonatal period is of special significance because it is a major cause of death (7.3%)¹⁷⁾ in the neonates. The high mortality rate among patients with congenital cardiac malformations during the neonatal period has been documented by previous reports.¹⁾⁻³⁾ Approximately one half to 2 thirds of these infants die within the first week of life.⁴⁾⁻⁸⁾

All previous reports observed were in the United States of America and Canada. There are no similar reports from Japan. The present study is an analysis of 107 cases admitted to the National Children's Hospital of Tokyo.

MATERIALS AND METHODS

From January, 1966 to June, 1969, 107 infants under the age of 30 days were admitted to the National Children's Hospital of Tokyo with severe cardiac symptoms such as serious cyanosis, anoxic spells, tachycardia, tachypnea, respiratory

From the Department of Pediatric Cardiology, National Children's Hospital, Tokyo.

Mailing address: Norio Matsuo, M. D., National Children's Hospital, Tokyo, 3-35-31 Taishido, Setagaya-ku, Tokyo.

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distress, or congestive heart failure. Patients with noncardiac anomalies who had severe cardiac symptoms were included. Patients with incidental nonserious heart disease were eliminated. There were no stillborn infants.

All patients were treated immediately upon arrival and when possible cardiac catheterization and cineangiocardioqram, surgical procedure, or if expired an autopsy. All diagnosis were made by cardiac catheterization, cineangiocardioqram, and/or autopsy.

RESULTS

Cardiac diagnostic classification (Table I)

The 3 most frequent types of cardiac malformations encountered were coarctation of the aorta syndrome, ventricular septal defect, and complete transposition of the great vessels (38.3%). Of the remaining cardiac defects were endocardial cushion defect, total anomalous pulmonary venous return, hypoplastic left heart syndrome, tetralogy of Fallot, patent ductus arteriosus, and asplenia syndrome (39.2%). These cardiac anomalies accounted for approximately 3 fourths of all cases. Hemodynamically, approximately 3

Table I. The Incidence of Serious Congenital Heart Disease
in the Neonatal Period

Cardiac malformation	Number	Incidence (%)
Coarctation of the aorta syndrome	15	14.0
Ventricular septal defect	14	13.1
Complete transposition of the great vessels	12	11.2
Endocardial cushion defect	9	8.4
Total anomalous pulmonary venous return	8	7.5
Hypoplastic left heart syndrome	7	6.5
Tetralogy of Fallot	7	6.5
Patent ductus arteriosus	6	5.6
Asplenia syndrome	5	4.7
Taussig-Bing's heart	3	2.8
Origin of both great vessels from the right ventricle	3	2.8
Pulmonary stenosis with intact ventricular septum	3	2.8
Endomyocardial disease	3	2.8
Tricuspid atresia	2	1.9
Multiple valvular disease	2	1.9
Interruption of the aortic arch	1	0.9
Pulmonary stenosis with ventricular septal defect	1	0.9
Aortic stenosis	1	0.9
Absence of pulmonary valve with ventricular septal defect	1	0.9
Miscellaneous	4	3.7
Total	107	100.0

fourths had increased pulmonary blood flow or congestion of pulmonary venous blood and approximately 25% had decreased pulmonary vasculature.

Coarctation of the aorta syndrome was present in 15 cases and preductal in 14 cases (narrow segment 11 cases, localized 3 cases). One case localized coarctation of the aorta opposed the patent ductus. In 7 of these cases, there was an associated ventricular septal defect and in 6 an associated patent ductus arteriosus. All 3 abnormalities were present in 2 cases. Three of these cases also had bicuspid aortic valve and one of them had bicuspid pulmonary valve at autopsy. Two cases of preductal localized coarctation associated with patent ductus arteriosus also had anomalous origin of the right pulmonary artery from the ascending aorta.⁹⁾

A ventricular septal defect was found in 14 cases. All patients had severe cardiac symptoms and infection or serious noncardiac anomalies simultaneously.

A complete transposition of the great vessels occurred in 12 cases. There were 8 patients with the simple form of transposition (d-transposition) with either an intact ventricular septum 1 with pulmonary stenosis and 2 with ventricular septal defect. Two cases had l-transposition with ventricular septal defect.

Endocardial cushion defects were found in 9 cases. There was a complete common atrioventricular canal in all. Six cases autopsied showed complete clefts of the mitral and tricuspid valves. Two of these demonstrated associated subaortic stenosis.

Total anomalous pulmonary venous return occurred in 8 cases. All of these had pulmonary venous obstruction. The common channel returned into the infracardiac vein in 5 cases (portal vein in 4 and mainly left gastric vein in 1), into the superior vena cava in 2 cases, and into the coronary sinus in 1 case.

Hypoplastic left heart syndrome was found in 7 cases. Autopsy was performed in 6 cases. There was mitral atresia in 3 cases, mitral and aortic atresia in 1 case, and mitral and aortic stenosis associated with hypoplastic tract in 3 cases. Four cases had a large atrial septal defect and 2 cases had a patent foramen ovale at autopsy.

Tetralogy of Fallot occurred in 7 cases. All of them had severe pulmonary stenosis or pulmonary atresia.

Patent ductus arteriosus was considered to be pathologic when the diameter of the ductus was found to be greater than 6mm. Six cases were found in the present study. Autopsy was performed in 5 cases who had the same size ductus with the descending aorta. One patient had surgery at 6 months of age and survived.

Asplenia syndrome occurred in 5 cases. The results of 4 autopsy cases

Table II. Pathological Cardiovascular Findings in the Autopsied
Asplenia Syndrome

Cardiovascular	1. Death at 16 days	2. Death at 3 months	3. Death at 48 days	4. Death at 3 months
Apex	left	unidentified	right	right
Right superior vena cava return into	?	right sided atrium	right sided atrium	right sided atrium
Left superior vena cava	—	—	into left sided atrium	into left sided atrium
Inferior vena cava return into (azygos or hemi- azygos system)	right sided atrium (—)	right sided atrium (—)	right sided atrium (—)	right sided atrium (—)
Secundum atrial septal defect	— patent foramen ovale	+	— patent foramen ovale	+
Atrioventricular orifice	common	common	common	common
Atrial relationship	normal	unidentified	unidentified	unidentified
Ventricle	single with small outlet chamber	single with small outlet chamber	large ventricular septal defect	inversion, vent- ricular septal defect
Relationship of the great vessels	complete transposition	normal	partial transposition	inverted partial transposition
Pulmonary vein return into	right sided atrium	left sided atrium	left superior vena cava	stomach vein
Pulmonary artery	atresia	stenosis	atresia	stenosis
Ductus arteriosus	patent	probe	patent	probe
Aortic arch	left	left	left	left
Lung (both side)	three-lobed	three-lobed	three-lobed	three-lobed
Other	situs inversus totalis	none	none	situs inversus totalis

are shown in Table II.

Taussing-Bing malformation was found in 3 cases, 2 were left sided type and one right sided type.¹⁰⁾ The origin of both great vessels from the right ventricle was found in 3 cases. All had pulmonary atresia in addition.

Two cases of tricuspid atresia were found in this series. One case also had pulmonary atresia and the other had a large ventricular septal defect, neither had pulmonary hypoplasia.

Two cases showed multiple valvular disease. One had stenosis of all 4 cardiac valves and the other had stenosis of all except the aortic valve.

There were no cases of hypoplastic right heart syndrome. Miscellaneous classification includes complicated cardiac anomalies such as dextrocardia with situs solitus of the atria, inversion of the ventricles with inverted complete transposition of the great vessels, common atrioventricular orifice, and pulmonary stenosis.

Noncardiac anomalies with severe cardiac symptom (Table III).

Table III. The Incidence of Noncardiac Anomalies Associated with Serious Congenital Heart Disease During the Neonatal Period

Cardiac malformation (numbers of all cases)	Associated with					Total numbers and Incidence (%)	
	Down's syndrome	Trisomy 18	Trisomy 13-15	Multiple anomalies	All others		
Coarctation of the aorta syndrome (15)	0	2	0	1	1	4	26.7
Ventricular septal defect (14)	1	0	1	1	1	4	28.6
Endocardial cushion defect (9)	7	0	0	0	0	7	77.8
Hypoplastic left heart syndrome (7)	0	1	0	0	0	1	14.3
Tetralogy of Fallot (7)	1	0	0	0	1	2	28.6
Patent ductus arteri- osus (6)	0	0	0	1	3	4	66.7
Origin of both great vessels from the right ventricle (3)	0	2	0	0	0	2	66.7
Multiple valvular disease (2)	0	1	0	0	1	2	100.0
Tricuspid atresia (2)	0	0	0	0	1	1	50.0
Micellaneous (4)	1	0	0	0	0	1	25.0
Total	10	6	1	3	8	28/107	26.2

Noncardiac malformations were observed in 28 cases or 26.2%. There were 17 cases of chromosomal abnormality; i.e. 10 of Down's syndrome, 6 of trisomy 18, and 1 of trisomy 13-15. In Table II, all others included 2 cases of anal atresia (tricuspid atresia and coarctation of the aorta syndrome), 1 case of cleft-palate and lip (tetralogy of Fallot), 2 cases of tracheoesophageal fistula (patent ductus arteriosus), congenital rubella syndrome (patent ductus arteriosus), Gargoylism (multiple valvular disease), trisomy 18 (multiple valvular disease), and aplasia of pituitary and adrenal glands (ventricular septal defect). Noncardiac abnormality occurred most frequently in association with multiple valvular disease (100%) and endocardial cushion defect (77.8%).

Prognosis (Table IV)

The overall mortality rate within the first 30 days of life was 32 or 29.9%. The total mortality rate within the first 60 days was 59 or 55.1% and 71 or 66.4% died within the first 90 days after birth. All survival cases over 3 months of complete transposition of the great vessels and coarctation of the aorta had received balloon atrial septotomy¹²⁾ or surgical procedure.

Sixteen or 22.5% of patients that expired within the first 90 days of life had associated noncardiac abnormalities.

Table IV. Prognosis of Serious Congenital Heart Disease
in the Neonatal Period

Cardiac malformation (Number of case)	Deaths				Total number of deaths and mort- ality rate under 90 days (%)	
	—30 days	—60 days	—90 days	91 days—		
Coarctation of aorta syndrome (15)	6 (2)	6	1	2 (2)	13	86.7
Ventricular septal defect (14)	2 (2)	1	0	2 (1)	3	21.4
Complete transposition of the great vessels (12)	1	5	3	1	9	75.0
Endocardial cushion defect (9)	1 (1)	2 (1)	1 (1)	2 (1)	4	44.4
Total anomalous pulmonary venous return (8)	4	3	1	0	8	100.0
Hypoplastic left heart syndrome (7)	6 (1)	0	1	0	7	100.0
Tetralogy of Fallot (7)	0	0	0	1 (1)	0	0
Patent ductus arteriosus (6)	3 (3)	1 (1)	0	1 (1)	4	66.7
Asplenia syndrome (5)	1	1	3	0	5	100.0
Taussig-Bing's heart (3)	0	2	1	0	3	100.0
Origin of both great vessels from the right ventricle (3)	2 (1)	1 (1)	0	0	3	100.0
Pulmonary stenosis with intact ventricular septum (3)	0	0	1	0	1	33.3
Endomyocardial disease (3)	1	1	0	0	2	66.7
Tricuspid atresia (2)	0	1	0	0	1	50.0
Multiple valvular disease (2)	1 (1)	0	0	0	1	50.0
Interruption of the aortic arch (1)	0	1	0	0	1	100.0
Pulmonary stenosis with ventricular septal defect (1)	1	0	0	0	1	100.0
Aortic stenosis (1)	0	1	0	0	1	100.0
Absence of pulmonary valve with ventricular septal defect (1)	0	1	0	0	1	100.0
Miscellaneous (4)	3 (1)	0	0	1	3	75.0
Total (107)	32 (12)	27 (3)	12 (1)	10 (6)	71	66.4
Total mortality rate	29.9%	55.1%	66.4%	75.7%		

Numbers in parenthesis represent patients with associated noncardiac anomalies.

DISCUSSION

Hospital statistics for congenital heart disease in newborn period have been previously categorized into 3 groups.⁶⁾ 1) autopsy,^{4)-7), 13), 14)} 2) clinical recognition including cardiac catheterization, and 3) a combination of both approaches. The most useful data during this period are undoubtedly that gathered by the third method.^{3), 8), 15)} In the present study, we utilized this approach. Varghese et al.¹⁵⁾ did not report the incidence of noncardiac anomalies and Lambert et al.⁷⁾ excluded noncardiac anomalies. It is some-

times difficult to be certain if the major causes of death is cardiac or secondary to the associated anomalies. We believe that statistics should include non-cardiac anomalies.

In agreement with previous reports,^{1), 2), 4)} about one third of our patients died within the first month of life. Approximately one half of the reported deaths occurred during the first week after birth.^{4)–8)} The same incidence probability exists in our series.

Autopsy series^{4), 5), 14)} presented 3 major groups of malformations; hypoplastic left heart syndrome, coarctation of the aorta syndrome, and simple transposition of the great vessels. Reports using a combined autopsy and clinical approaches¹⁵⁾ showed 75% of malformation was simple transposition of great vessels, ventricular septal defect, patent ductus arteriosus, coarctation of the aorta syndrome, hypoplastic left heart syndrome, hypoplastic right heart syndrome, truncus arteriosus, and tetralogy of Fallot. Our results showed a high incidence of coarctation of the aorta syndrome, ventricular septal defect, complete transposition of the great vessels, and hypoplastic left heart syndrome, similar to Varghese's series.¹⁵⁾ However, the incidence of endocardial cushion defect (8.4%) and total anomalous pulmonary venous return (7.5%) was higher than all autopsy series (2% and 2%)^{4), 5), 14)} and combined series (2% and 0%).^{7), 8), 15)}

We observed 14 cases of isolated ventricular septal defect in our series. Most infants, died early in life, had associated noncardiac anomalies, but the major cause of death could not be determined. In some cases of isolated ventricular septal defects without noncardiac anomalies, several had serious cardiac symptoms during the neonatal period but survived with medical treatment. Most cases of patent ductus arteriosus with serious cardiac signs during the neonatal period also had noncardiac anomalies. However, it is certain that the symptoms were made worse by the presence of the pathological patency of the ductus. Because the Buffalo series^{7), 8)} did not include cases associated with noncardiac disease, they have no statistics for the incidence of non-isolated ventricular septal defect and patent ductus arteriosus.

Incidence of the association with noncardiac anomalies in our series (26.2%) agrees with the autopsy series of Mehrizi (27%).⁵⁾

No case of complete transposition of the great vessels was associated with noncardiac anomalies. This result is similar to that reported previously in the Occident.^{5), 6)} In addition, in our series, no case of total anomalous pulmonary venous return was associated with noncardiac anomalies.

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