Two-Dimensional Echocardiographic Classification of Persistent Truncus Arteriosus

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SUMMARY

Three cases with persistent truncus arteriosus, a 1-year-old boy with a type I, an 8-month-old girl with a type II, and a 5-year-old girl with type II, all confirmed by surgery, were studied by two-dimensional echocardiography (2-DE). The 2-DE findings corresponded well with the actual anatomy as determined by direct visualization as well as angiogram. A "piling-up" method using 2-DE to reconstruct three-dimensional anatomical images is useful in making the correct diagnosis of persistent truncus arteriosus as well as typing this anomaly noninvasively.

Additional Indexing Words:
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PERSISTENT truncus arteriosus is a relatively rare cardiac malformation,1–3) which necessitates early accurate diagnosis and surgery for survival and to avoid pulmonary vascular obstruction. M-mode echocardiography is a useful, noninvasive method for establishing the differential diagnosis of this anomaly as documented by French and Popp in 1975.4) The detection of the presence of two semilunar valves excludes some of the congenital heart diseases mimicking this defect, such as aorticopulmonary window,5) patent ductus arteriosus associated with pulmonary hypertension with or without ventricular septal defect, anomalous origin of the right pulmonary artery from the ascending aorta, etc. The purpose of this study is to demonstrate the ability to diagnose persistent truncus arteriosus as well as to classify this anomaly correctly and noninvasively by using two-dimensional echocardiography (2-DE).
SUBJECTS AND METHODS

We have studied persistent truncus arteriosus in 3 patients ranging in age from 8 months to 5 years by 2-DE. One of these cases was classified as type I (Collett and Edwards) and the remaining two type II angiographically. The diagnoses were all confirmed at surgery.

2-DE examination for the diagnosis of congenital heart disease (CHD) is routinely performed in our institute as we reported previously. The spatial structure of the great arteries is best reconstructed by a "piling-up" method. The echo planes used for this approach are the transverse or short axis views of the great artery (GA). If only one GA is detected, the short axis view of this GA is utilized; if two GAs are detected, the short axis view of the posterior GA is used. These short axis planes of the GA are designated +1 to +4 from the root of the GA to the aortic arch. Plane

![Diagram of great arteries with echo planes]

Fig. 1. Serial short axis echo planes of the great arteries (GAs) from the aortic root (plane +1) to the aortic arch (plane +4) illustrating the normal spiral GAs (left panel). The two-dimensional echocardiographic findings are shown in the right panel. The two semilunar valves are observed in right posterior inferior and left anterior superior positions in planes +1 to +2. The left anterior GA is extended posteriorly in plane +3 and the right posterior GA is finally extended in +4. By "piling-up" these findings, the three-dimensional structure as shown in the left panel can be accurately reconstructed. AV=aortic valve; PV=pulmonary valve; PA=right atrium; LA=left atrium; Ao=aorta; PA=pulmonary artery.
+1 is defined as the plane where the posterior semilunar valve is visualized, plane +2 is a slightly more cranial plane where the anterior semilunar valve is seen, plane +3 is the plane in which one of the GAs extends posteriorly and plane +4 is further angulated toward the head and is the plane where the remaining GA also extends (Fig. 1). In a case with normally related GAs, the posterior semilunar valve (aortic valve) is seen to the right posteriorly in plane +1, then as the echo plane is shifted toward the head from plane +1, the anterior semilunar valve (pulmonary valve) is seen to the left side of the posterior semilunar valve. The left anterior GA is initially extended posteriorly in the echo of plane +3 which is slightly cranial to plane +2. Therefore the left anterior GA is identified as the pulmonary artery because these findings show the spiral interrelationship of the GAs and the branching off of the pulmonary artery. The remaining right posterior GA also extends posteriorly in echo plane +4 which is further angulated cranially. This finding reveals the aortic arch. By "piling-up" these 2-DE images from plane +1 to plane +4 the spatial structure of the GAs can be reconstructed. The following 3 cases with persistent truncus arteriosus were studied by 2-DE in the same manner.

**Case 1. Y.F. (#157589)**

In this 1-year-old boy, cyanosis was first noticed at the age of 1 week. Cardiac catheterization was performed and a diagnosis of persistent truncus arteriosus type I was made. He was referred to this hospital for surgery. The ECG showed combined ventricular hypertrophy and the chest X-ray showed moderate cardiomegaly. The peripheral pulses were bounding. The angiogram of Case 1. The contrast medium was injected into the truncus arteriosus during right heart catheterization. The diagnosis of persistent truncus arteriosus type I was made.
cardiogram is shown in Fig. 2. Contrast medium was injected into the truncus via a right heart catheter. The main pulmonary artery was seen to branch off to the right posteriorly from the truncus and then divide into right and left pulmonary artery branches. The two-dimensional echocardiographic findings are shown in Fig. 3. A large great artery was detected in plane +1. As the echo plane was tilted toward the head, the distance between the anterior and posterior walls of the GA narrowed and appeared as an "hour glass" shape, and the right posterior extension from the left half of this GA was observed in plane +2. The original single large GA was now clearly divided into two GAs and the left posterior extension of the left sided GA was seen in plane +3. The remaining right sided GA was extended to the left posteriorly in plane +4. Tr=truncus arteriosus; PA=pulmonary artery.
Fig. 4. The angiogram of Case 2. The right and left pulmonary arteries both branch directly from the posterior wall of the truncus. The diagnosis of truncus arteriosus communis type II was made. The left pulmonary artery originates at a slightly higher level. Tr = truncus arteriosus; r-PA = right pulmonary artery; l-PA = left pulmonary artery; Ao = aorta.

divided into two GAs and the left posterior extension of the left-sided GA was seen in plane +3. The remaining right-sided GA was extended to the left posteriorly in plane +4. The diagnosis of persistent truncus arteriosus type I was confirmed by direct visualization at surgery.

Case 2. C.O. (#169924)

An 8-month-old girl was admitted for correction of a persistent truncus arteriosus type II which had been diagnosed by cardiac catheterization prior to the referral. On admission, no cyanosis was seen. Peripheral pulses were bounding and a blood pressure of 96/30 mmHg was recorded. The ECG showed combined ventricular hypertrophy and a chest X-ray revealed mild cardiomegaly with pulmonary plethora. The angiogram is shown in Fig. 4. The right and left pulmonary arteries both branch directly from the posterior wall of the truncus arteriosus. The left pulmonary artery was slightly smaller in size and originated from a slightly higher point than the right pulmonary artery. The 2-DE is shown in Fig. 5. A large GA was seen in plane +1. The posterior extension of the right posterior portion of the GA and the left posterior extension of the GA were visualized in plane
Fig. 5. The two-dimensional echocardiogram of Case 1. A large great artery (GA) is seen in plane +1. The posterior extension of the right posterior portion of the GA was observed in plane +2 and a left posterior extension of the GA was seen in plane +3. The large GA finally extends itself posteriorly in plane +4. Tr = truncus arteriosus; r-PA = right pulmonary artery; l-PA = left pulmonary artery; SVC = superior vena cava.

+2 and plane +3, respectively. Finally, the large GA was seen to extend to the left posteriorly in plane +4. The diagnosis of persistent truncus arteriosus type II with higher branching of the left pulmonary artery was confirmed by direct visualization at surgery.

Case 3. T.M. (#170149)

A 5-year-old girl was admitted with a diagnosis of a large left to right shunt associated with pulmonary hypertension. No cyanosis was seen. The findings of combined ventricular hypertrophy on ECG, pulmonary hypervascularity on the chest X-ray and bounding pulses indicated the presence of aorticopulmonary communication. The angiogram is shown in Fig. 6. Large bilateral pulmonary arteries directly branch off from the posterior wall of
the truncus arteriosus at the same horizontal level. The diagnosis of persistent truncus arteriosus type II with a right aortic arch was made. 2-DE findings performed prior to cardiac catheterization are shown in Fig. 7. A large GA was visualized in plane +1. A slightly posterior extension of the GA was seen in plane +2. Posterior extension and branching off of the GA toward the right and left was seen in plane +3, and right posterior extension of the remaining anterior part of the GA was observed at plane +4. The diagnosis of persistent truncus arteriosus type II with both pulmonary arteries branching off the truncus at the same horizontal level was confirmed by direct visualization at surgery.

Discussion

Persistent truncus arteriosus should be considered as a differential diagnosis in cases with pulmonary plethora combined ventricular hypertrophy and bounding pulses. As documented previously by French and Popp, 4) M-mode echocardiography was a useful tool for differentiating truncus arteriosus from other anomalies such as patent ductus arteriosus with pulmonary
hypertension with or without ventricular septal defect, aorticopulmonary window,\textsuperscript{5}) and anomalous origin of the right pulmonary artery from the ascending aorta in those cases where two semilunar valves could be detected. But now, this anomaly can be diagnosed morphologically by using 2-DE.\textsuperscript{11–13})

Moreover, by using the echocardiographic “piling-up” method as illustrated above, we cannot only make the correct diagnosis but also classify the type of the anomaly. Case 1 was diagnosed as persistent truncus arteriosus type I from the angiogram. The three-dimensional structure reconstructed by 2-DE is concordant with the spatial structure of a type I truncus arteriosus. Although Cases 2 and 3 were both diagnosed as type II persistent truncus arteriosus by angiogram, the actual spatial structures were recognized as being
different. The left pulmonary artery was smaller and arose higher from the truncus arteriosus in Case 2, whereas in Case 3 the pulmonary arteries were of almost equal size and arose from the same horizontal level. The 2-DEs of Cases 2 and 3 showed the actual anatomical three-dimensional structures.

Thus we conclude that 2-DE is more useful than M-mode echocardiography as a diagnostic tool not only for making an accurate noninvasive diagnosis but also for classifying the type of persistent truncus arteriosus.

REFERENCES