Desc ending Aorta Index and Pulmonary Artery Index in Infants Comparison between Atrioventricular Septal Defects, At ial Septal Defects and Ventricular Septal Defects

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=국문초록=

심방실 중격 결손증에서의 하행대동맥, 폐동맥 지수

Jae I › Ahn, M.D.*, Christopher J. Knott-Craig, M.D.**, Ronald C. Elkins, M.D.**

심방실 중격 ; 손증 환아의 하행 대동맥이 심혈관 조영상에서 작게 보이는 원인을 규명하기 위하여 혈역학적 관ᄌ 등을 조사하였다. 1세 미만의 심방실 중격 결손증으로 Oklahoma University Health Sciences Cente 에서 수술 치료를 받았던 34명의 심혈관 조영상을 좌우 단락의 비가 비슷한 10명의 심방 중격 결; 증 및 10명의 심실 중격 결손증 환아들과 비교한 결과 하행 대동맥 지수(DAI)는 질환간에 차이를 보이지 않았지만(147.9 ± 34.8 mm²/m² 및 158.6 ± 31.5 mm²/m², 153.2 ± 43.1 mm²/m²), 폐동맥 지수(PAI)에 있어서는 심방실 중격 결손 환아에서 훨씬 크게 나타나고 있었다(684.3 ± 170.7 mm m² 및 454.1 ± 109.1 mm²/m², 534.9 ± 148.4 mm²/m²) ($p < 0.05$). 또한 폐동맥압 및 폐-체혈관 저항 에 있어서도 심방실 중격 결손 환아에서 높게 나타나고 있다(43.1 ± 15.6 mmHg 및 29 ± 11.6 mmH; 24 ± 8.1 mmHg) (0.27 ± 0.22 및 0.14 ± 0.03, 0.11 ± 0.05) ($p < 0.05$). 즉 심방실 중격 결손 환아에서 심혈관 조영상의 작게 보이는 하행 대동맥은 다른 심질환에 비해 훨씬 큰 폐동맥에 의한 착시적 ᄒ 상임을 알 수 있었다.

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중심 단어 : 심방실 중 ᄒ 결손증, 하행 대동맥 지수, 폐동맥 지수

INTRODU :TION

Infants with atrioventricular s ɔtal defect (AVSD) usually have excessive pulmonary bloc flow resulting in uncontrollable cardiac failure and rapi y progressive pulmonary vascular obstructive disease (PVC)[1, 2]. Primary repair is therefore advocated within the fi t year of life to reduce the exposure time of the pulmoı ry vasculatures to the systemic pressure environment[3-7].

In our preoperative angiographic evaluation of infants with AVSD, we observed that the descending aorta often appeared unusually small. This obsevation prompted us to review the angiographic data on our patients with AVSD, and compare them to patients with excessive pulmonary blood flow due to other congenital heart defects. The results of this investigation forms the basis of this manuscript.

PATIENTS AND METHOD

From May 1985 to April 1992, 43 consecutive infants under 1 year of age underwent primary repair of complete AVSD at the Children's Hospital of Oklahoma University. In 34, cardiac catheterization and cineangiographic data

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Table 1. Preoperative cardiac catheterization and cineangiographic data in infants with AVSD, ASD and VS

	DAI(mm²/m²)	PAI(mm²/m²)	PAI/DAI	PAP(mmHg)	Rp/Rs	Qp/Qs
AVSD	147.9 ± 34.8	684.3 ± 170.7	4.99 ± 1.77	43 ± 15.6	0.27 ± 0.22	3.4 ± 1.5
ASD	153.2 ± 43.1	534.9 ± 148.4*	3.6 ± 0.92*	24 ± 8.1*	0.11 ± 0.05	3.4 ± 1.1
VSD	158.6 ± 31.5	454.1 ± 109.1*	2.89 ± 0.81*	29 ± 11.6*	0.14 ± 0.0	3.3 ± 1.2

AVSD : atrioventricular septal defect, ASD : secundum type atrial septal defect, VSD : perimembranous ventricular septa efect, (* means $p < 0.05$)
DAI : descending aorta index, PAI : pulmonary artery index, PAI/DAI : ratio of PAI to DAI, PAP : pulmonary artery p ssure,
Rp/Rs : pulmonary to systemic vascular resistance ratio, Qp/Qs : intracardiac shunt ratio

were available for review, and these constitute the AVSD study group. None of these patients had other significant associated cardiac disease, and neither did have any left ventricular outflow tract obstruction. The patient cohort included both Down's (n = 18) and non-Down's (n = 16) patients.

For comparison, we identified 10 patients from the same time period with isolated perimembranous Ventricular Septal Defects (VSD), and 10 with secundum-type Atrial Septal Defects (ASD), who were matched for age, size, and pulmonary blood flow.

The catheterization data and cineangiograms of all these patients were reviewed by one of us (JHA), and the collected data entered in a single data base.

Measurements of Aorta and Pulmonary Arteries :

Using the preoperative angiograms, the aorta was measured at the level of the diaphragm, and both right and left pulmonary arteries at the level of their first lobar branches ; these measurements were made during systole, corrected for magnification, and recorded. The cross-sectional area was then calculated, summated in the case of the pulmonary arteries, and indexed to the patient's body surface area. This was recorded as the descending aortic index (DAI), and the pulmonary artery index (PAI) respectively[8,9]. The ratio of PAI to DAI (PAI/DAI) was also calculated and recorded.

All data were expressed in terms of mean ± standard deviation. The data were compared using the Student T-test, and Fisher's exact test. Correlations were done using Pearson's correlation coefficient. Comparisons were cosidered significant at a p-value of < 0.05.

RESULTS

The DAI of the infants wi AVSD was 147.9 ± 34.8 mm²/m², similar to those of t patients with VSDs (158.6 ± 31.5 mm²/m²), and to thc with ASDs (153.2 ± 43.1 mm²/m²) (P = NS), refuting r observation that the descending aorta in patients wit AVSD was small compared to other patients with simil ly large left-to-right intracardiac shunts. However, the ulmonary artery size (PAI) in the AVSD patients (684.3 ± 70.7 mm²/m²) was significantly larger than the VSD ar ASD patients (454.1 ± 109.1 mm²/m² and 534.9 ± 148 mm²/m² respectively) ($p < 0.05$). The PAI/DAI ratio as correspondingly also larger (4.99 ± 1.77 versus 2.89 0.81, 3.6 ± 0.92) ($p < 0.05$). These measurments sugge that the apparent descending aortic hypoplasia in infan with AVSD stemmed from the fact that the pulmonary arteries are significantly larger than the comparable grc ps, creating this illusion. These data are summarized in T ble 1.

Although the Qp/Qs mongst the AVSDs, VSDs, and ASDs groups were almc identical (3.35 ± 1.49 versus 3.28 ± 1.18, 3.37 ± 1.14), bc h the mean PA pressure and vascular resistance ratio (R /Rs) in the AVSD group were significantly higher than he other groups : 43 ± 15.6 mmHg versus 29 ± 11.6 mmH , 24 ± 8.1 mmHg ($p < 0.05$), and 0.27 ± 0.22 versus 0. ± 0.03 and 0.11 ± 0.05 ($p < 0.05$) respectively, suggestin that the pulmonary vascular resistance is more rapidly progressive, and at an earlier age in patients with AVSD.

When we plotted t ose relationship between PA pressure and PA Index, we f und a close correlation ($r = 0.48$, $p <$

0.01, CL > 95%) only in the AVSD group (Fig 1), but not in the VSD or ASD groups.

DISCUSSION

In order to evaluate the size of the great arteries from angiograms in our analysis, we needed to select reference points from which comparisons could be made. In the past there have been many attempts to standardize the measurement of aorta and pulmonary artery size in order to make these comparison more legitimate[8~12]. The PAI is currently used to describe pulmonary artery size in other cyanotic congenital heart defects[8, 9], and the DAI evolved as the logical extension thereof; the premise of relating the pulmonary artery size to that of the descending aorta is well established[12, 13]. Use of the PAI, DAI and PAI/DAI ratio, allowed us to resolve the clinical question is the descending aorta really small in patients with AVSD?

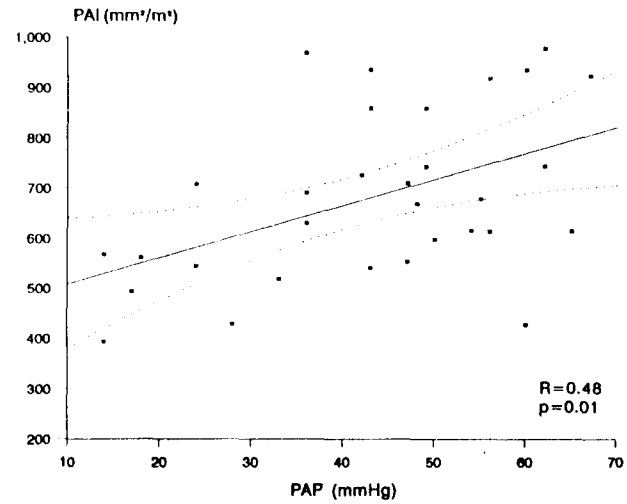

Fig. 1. The Correlation between the PA index and PA pressure in AVSD patients ($r = 0.48$, 95% CL $p < 0.01$).

Our analysis established that the size of the descending

=**Abstract**=

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To clarify the apparent hypoplasia of the descending aorta in infants with atrioventricular septal defect (AVSD) patients, we reviewed the catheterization data and angiograms of 34 consecutive patients with AVSD less than 1 year of age who underwent repair at our institution since 1985. We compared them to 10 patients with Atrial Septal Defect (ASD) and 10 patients with Ventricular Septal Defect (VSD) who were matched for age, size and Qp/Qs. The Descending Aorta Index (DAI) of the AVSD group was not different from the VSD or ASD groups ($147.9 \pm 34.8\,mm^2/m^2$ versus $158.6 \pm 31.5\,mm^2/m^2$ and $153.2 \pm 43.2\,mm^2/m^2$). However, the Pulmonary Artery Index (PAI) of the AVSD group was significantly larger than the other groups ($684.3 \pm 170.7\,mm^2/m^2$ versus $454.1 \pm 109.1\,mm^2/m^2$ and $534.9 \pm 148.4\,mm^2/m^2$) ($p < 0.05$), as was the ratio of PAI/DAI in the AVSD group (4.99 ± 1.77 versus 2.89 ± 0.81 and 3.6 ± 0.92) ($p < 0.05$). Despite similar Qp/Qs ratios, both the mean PA pressure and the Rp/Rs in the AVSD group was higher than the VSD and ASD groups: 43.1 ± 15.6 mmHg versus 29 ± 11.6 mmHg and 24 ± 8.1 mmHg ($p < 0.05$), and 0.27 ± 0.22 versus 0.14 ± 0.03 and 0.11 ± 0.05 ($p < 0.05$) respectively.

The apparent hypoplasia of the descending aorta in infants with AVSD is an illusion created by the abnormally large pulmonary arteries, which are significantly larger than in patients with ASDs or VSDs.

Key words: Descending Aorta Index (DAI), Pulmonary Artery Index (PAI), Atrioventricular Septal Defect (AVSD)

aorta in infants with AVSD is no different from that of comparable patients with large intracardiac shunts; however, the pulmonary arteries are significantly larger both relative to the descending aorta and in absolute terms[9]. They are also significantly larger than comparable patients with ASDs and VSDs. The significance of this observation is unclear at present, and merits further investigation. These results understandably differ from those which compare the size of the ascending aorta to that of the pulmonary arteries[10, 11], since the latter is more closely affected by intracardiac hemodynamics.

Jarmakani has previously shown that pulmonary atery size correlated better with pumnary artery pressure rather than with pulmonary blood flow[14]. Our data supports this conclusion but in patients with AVSD (fig. 1). We could find no useful correlation in the patients with either ASD or VSD.

Higher pulmonary vascular resistance, and earlier and possibly more progressive PVOD in the AVSD group compared to te ASD or VSD patients, may account for these observations[15, 16]. If true, this should further encourage the referral of patients for primary surgical correction of AVSD at an earlier age, preferrably within th first six months of life[3~7].

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