Coronary Artery Perfusion Scanning with ^{131}I-MAA Injected Directly into the Coronary Artery of Congenital Coronary Anomalies

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SUMMARY

5 μCi/Kg ^{131}I-MAA was injected into the right coronary arteries in Cases 1, 2, and 3 under the diagnosis of right coronary artery fistula, and in Case 4 under the diagnosis of Bland-White-Garland syndrome. The results were compared with the angiocardiogram and right heart catheterization. When a fistula is small and cardiac cavity at the opening is not visualized by the angiocardiogram, coronary perfusion scanning successfully disclosed the location of fistula and influence of coronary circulation.

Additional Indexing Words:

Coronary artery perfusion scanning ^{131}I-MAA Congenital coronary artery fistula Bland-White-Garland syndrome

CONGENITAL coronary artery anomalies are much rarer than coronary sclerosis. However, the effect of surgery is quite pronounced, as long as an accurate diagnosis is made and indications are correctly selected. Catheterization and angiography were used for the diagnosis of congenital coronary artery anomalies. In cases with small congenital coronary artery fistula, however, the amount of shunting is also small, and catheterization and angiocardiography alone are insufficient to clarify the site of the fistula and its influence on coronary circulation. When an anastomosis between the right and left coronary arteries is insufficient such as in Bland-White-Garland syndrome, it is difficult to demonstrate the characteristic retrograde flow to the pulmonary artery.

In 1969 we accomplished for the first time myocardial scanning through direct injection of ^{131}I-MAA through a catheter into the coronary artery in man.[1)]

Applying this method, findings in congenital coronary artery fistula and

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Bland-White-Garland syndrome were compared with right heart catheterization and angiocardiography.

Method

Four cases of congenital coronary artery anomalies were studied.

(1) Right heart catheterization

Presence or absence of left to right shunt was studied.

(2) Angiocardiography

Aortography or selective coronary arteriography was performed to make the diagnosis. In cases of congenital coronary artery fistula, the site and the abnormal coronary circulation were studied. In Bland-White-Garland syndrome, the state of the intercoronary anastomosis and the mode of retrograde flow from the left coronary artery to pulmonary artery as steal were also studied.

(3) Coronary artery perfusion scanning

In the coronary arteries of the abnormal side in Cases 1, 2, and 3 under the diagnosis of congenital coronary artery fistula, 5μCi/Kg of ^{131}I-MAA was injected. In Case 4 under the diagnosis of Bland-White-Garland syndrome, 5μCi/Kg ^{131}I-MAA was injected into the right coronary artery. The results were compared with the angiocardiogram.

Results

(1) Right heart catheterization

As shown in Table I, definite left to right shunt was noted in Cases 2 and 4. Indefinite left to right shunt was noted in Case 1.

Table I. Right Heart Catheterization

Diagnosis	Congenital coronary artery fistula			Bland-White-Garland syndrome
Case	1	2	3	4
Sex	Female	Female	Male	Female
Age	27	58	17	36
O_2 saturation				
SVC	72.5	65.0	66.5	65.0
IVC	74.0	68.5	74.0	74.0
RA (1)	75.0	66.5	69.5	69.0
(2)	74.0		71.0	
RV (1)	77.5	76.0	71.0	69.5
(2)			74.0	70.0
PA	80.5	76.1	74.0	83.0
Ao	96.0	98.0	96.0	99.0
Left to right shunt	28%	39%	negligible	47%

Definite left to right shunt was noted in Cases 2 and 4.

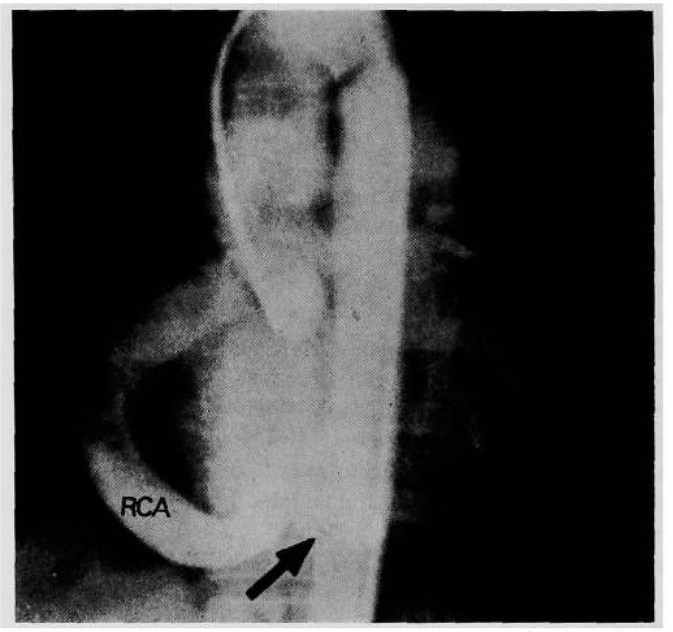

Fig. 1 a. Diagnosis was congenital coronary artery fistula. However, cardiac cavity at the opening was not visualized because fistulae were small.

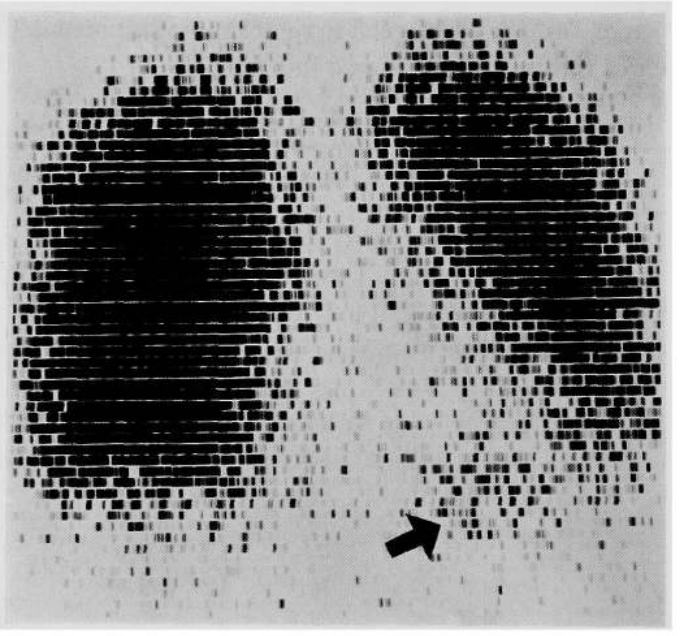

Fig. 1 b. Large amount of the infused ^{131}I-MAA was found to be taken up by the lung, and a small part was taken up by the myocardium, indicating the usefulness in arterial blood.

Fig. 2 a. Coronary arteriogram in a patient with a fistula between the right coronary artery and right ventricle.

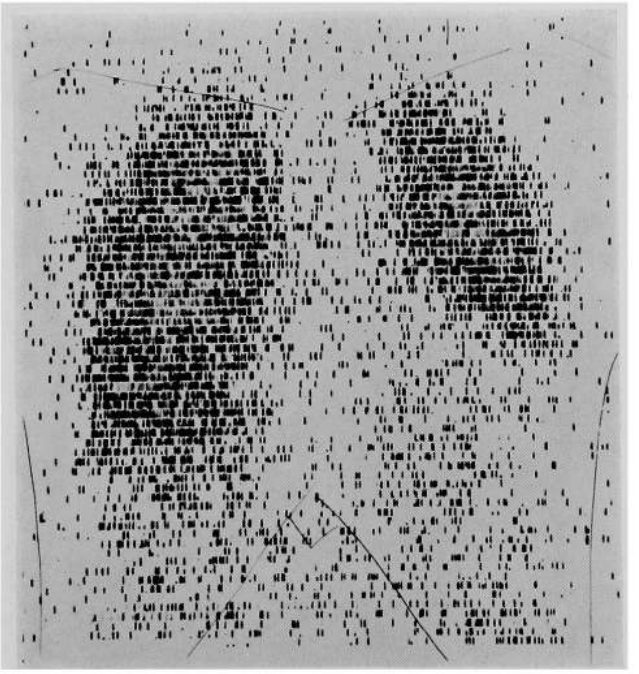

Fig. 2 b. Large amount of the infused ^{131}I-MAA was found to be taken up by the lung. Arterial blood was not supplied from the right coronary artery to the myocardium.

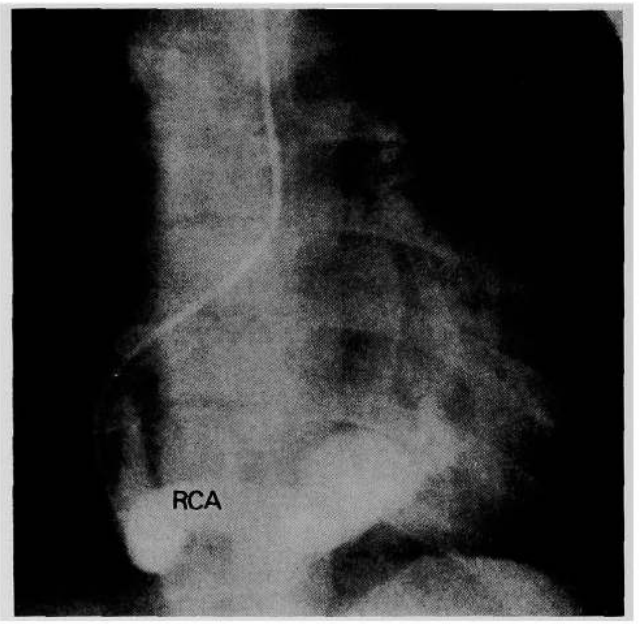

Fig. 3 a. Coronary arteriogram in a patient with a fistula between the right coronary artery and posterior wall of ventricle. However, it was not clarified whether this was right ventricle or left ventricle.

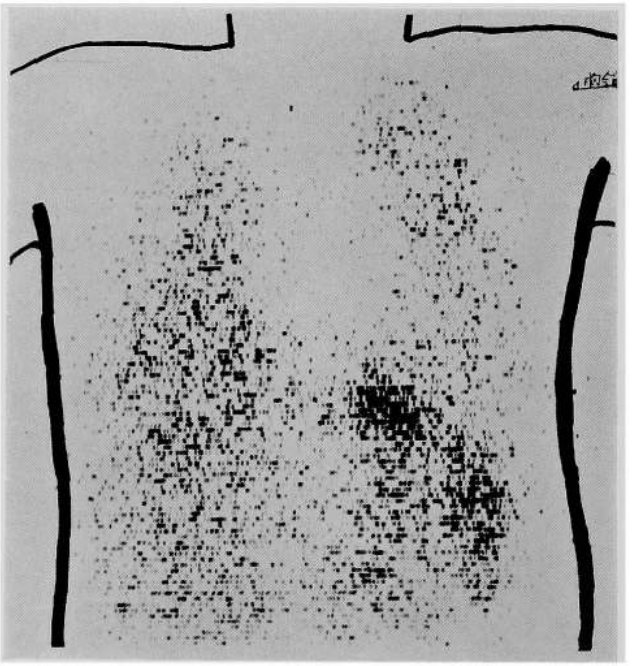

Fig. 3 b. In coronary artery perfusion scanning in this case, uptake into the systemic circulation was noted in the brain, kidney and liver, so that the site of opening of fistula was probably on the left heart side.

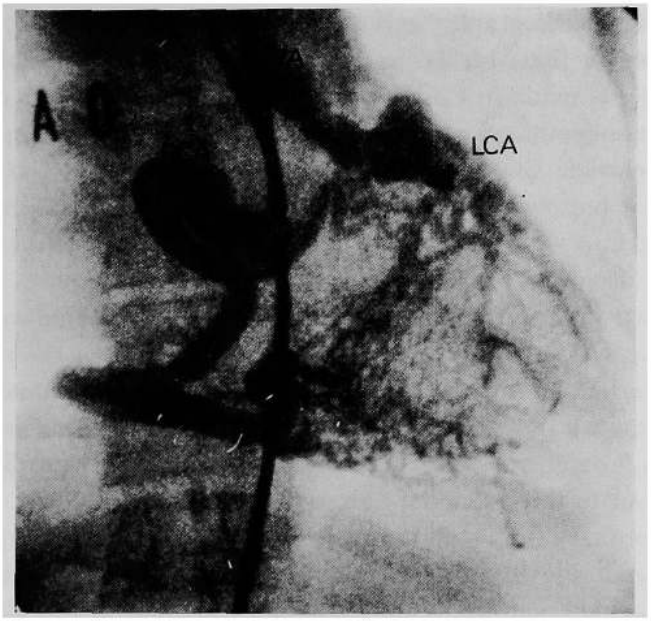

Fig. 4 a. Coronary angiography revealed marked anastomosis between the right and left coronary arteries. Retrograde flow was noted from the left coronary artery to pulmonary artery.

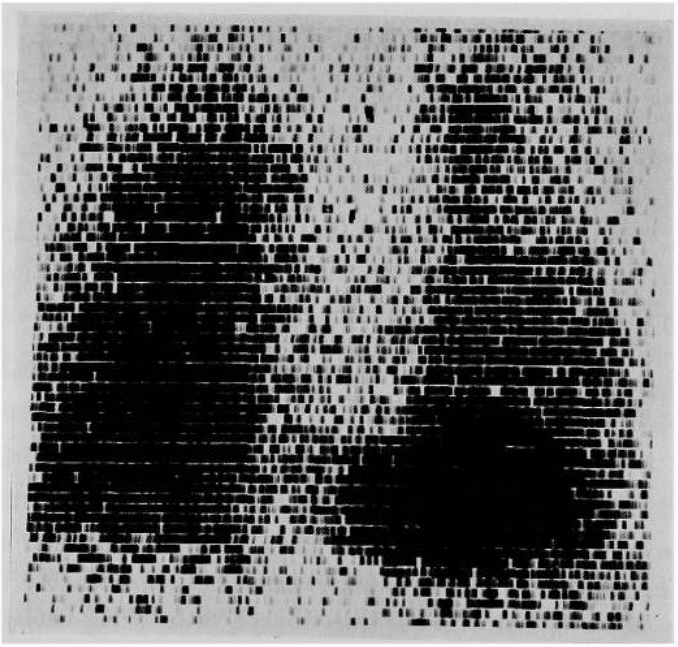

Fig. 4 b. As shown in this case, ^{131}I-MAA injected into the right coronary artery was distributed to coronary and pulmonary vascular bed.

(2) Angiocardiography

As shown in Figs. 1a, 2a, and 3a, the diagnosis of congenital coronary artery fistula was made in Cases 1, 2, and 3. In the follow-up of film series, the site of opening of the fistula in Case 2 was found to be on the posterior wall of the right ventricle, since the right ventricle was visualized. In Cases 1 and 3, however, no definite conclusion was drawn. Whether or not the right coronary artery in Cases 1, 2, and 3 was supplying arterial blood to the myocardium is difficult to decide by the method of visualization.

As shown in Fig. 4a, diagnosis of Bland-White-Garland syndrome was made in Case 4. A wide anastomosis was noted between the right and left coronary arteries. From the left coronary artery to the pulmonary artery, retrograde flow was noted. It is, however, unknown how much of the blood flow through the right coronary artery is supplied to the myocardium and how much leaks out to the pulmonary artery.

(3) Coronary artery perfusion scanning

As shown in Figs. 1b and 2b, most of the ^{131}I-MAA injected into the right coronary artery is taken up by the pulmonary vascular bed in Cases 1 and 2. In Case 1, the site of opening of the fistula could not be demonstrated by angiography, but coronary artery perfusion scanning successfully located it on the posterior wall of the right ventricle. In coronary artery perfusion scanning in Case 3, uptake into the systemic circulation was noted in the brain, kidney and liver; so that the site of opening of the fistula was probably on the left heart side. This was confirmed at surgery.

Whether or not the right coronary artery in Cases 1, 2, and 3 supplies artery blood to the myocardium is revealed by the radioactivity value in the myocardium. The right coronary artery in Case 2 apparently supplied little arterial blood to the myocardium.

As shown in Fig. 4b, ^{131}I-MAA injected into the right coronary artery was distributed to coronary and pulmonary vascular bed in Case 4 (Bland-White-Garland syndrome). Radioactivity noted in the pulmonary vascular bed corresponds to the retrograde flow escaping into the pulmonary artery from the left coronary artery.

Discussion

Myocardial scanning is classified largely into 2 groups. One is the method utilizing the difference in isotope uptake between ischemic and normal myocardium following intravenous injection of ^{86}Rb, ^{203}Hg-neohydrin, ^{131}Cs, ^{129}Cs, ^{43}K and radio-iodinated fatty acid (RIFA).[2)–7)] Another method consists of injection of isotope-labeled macroaggregated albumin into the coronary

artery.[8)-11)] Quinn[8)] caused cardiac standstill with acetylcholine and obstructed the ascending aorta with a balloon catheter to make all blood flow run into the coronary artery before injecting ^{131}I-MAA. The injected isotope filled the coronary vascular bed making possible myocardial scanning, according to the experimental results. However, combined use of cardiac standstill with acetylcholine is rather dangerous. The effect of obstruction of the coronary vascular bed by ^{131}I-MAA was not studied, and this method has not been applied clinically.

In 1969, the author injected macroaggregated albumin into the coronary vascular bed of an experimental dog at dose 100 times as great as that used in man,[9),10)] and confirmed the safety.[9),10)] The author established the method of selective injection of ^{131}I-MAA directly into the coronary artery via a catheter without using acetylcholine and was successful in using this method clinically. This method was used in more than 60 patients with ischemic heart disease, without complication.

In this section, an isotope method was used to diagnose congenital coronary artery anomalies and compared with right heart catheterization and angiocardiography.

Congenital coronary artery fistula:

When the fistula opens on the left side of the heart (left atrium and left ventricle), right heart catheterization is not helpful. When the fistula is small, no shunt is demonstrable even if the fistula opens on the right side of the heart (right atrium, right ventricle and pulmonary artery).

In cases with large fistulae when visualization of the heart cavity at the site of opening is possible, angiocardiography is an effective method. When a fistula is small and cardiac cavity at the opening is not visualized, coronary artery perfusion scanning is of more value. Presence or absence of supply of arterial blood via the coronary artery complicated by fistula cannot be decided on the basis of angiocardiography. Coronary artery perfusion scanning is necessary to clarify this.

As in Case 1, arterial blood was supplied from the right coronary artery to the myocardium, and coronary artery ligation by major surgery was avoided.

Bland-White-Garland syndrome:

Indications for ligation of the left coronary artery in this disease consist of favorable anastomosis between the right and left coronary arteries, along with considerable retrograde flow from the left coronary artery to the pulmonary artery.

When a large amount of opaque media is injected under high pressure in angiocardiography, erroneous findings are frequently obtained. When

coronary artery perfusion scanning is conducted, isotope should be injected into the coronary artery under a pressure close to zero, so that the diagnosis can be made under physiological conditions.

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