Scientifics basis for refusing complete repair of the heart in all cases of tetralogy of Fallot. Indications of the Potts and Blalock operation (1)

By

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In November of 1958[1], in the First National Congress of Cardiology of Perú, which was held in Lima, we presented a paper concerning the criteria that the surgeon should follow to carry out the complete reconstruction of the heart in cases of Tetralogy of Fallot.

According to this paper some cases can be reconstructed by means of the method suggested by Lillihei in 1956, while others can only be treated surgically with the anastomosis or extra cardiac derivations of Blalock or Potts.

This paper was originated by virtue of the fact that during the III International Congress of Cardiology[2], which was held in Brussels, Belgium, in September of 1958, two months before the Congress in Lima; only cardiac reconstruction of cases of Tetralogy of Fallot were discuseed while the operations of Blalock and Potts, which have saved so many lives, were not even considered.

We have subsequently completed others papers which will reenforce this criteria, which is followed by cardiologists, pediatrists and surgeons of our Foundation, criteria that we will firmly defend here.

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Very recently, on May 20 of 1958, Dr. Gross, of Boston[3] owing to the Shattuck Lecture on devoting himself to the surgical treatment of Tetralogy of Fallot was of the same opinion that while the operation of Dr. Lillihei was ideal in the surgical correction of these cases, there were many cases in wich it was impossible to carry out for a series of objections explained in a very clear manner.

In our peruvian paper, we said that in order for the cardiac reconstruction in Tetralogy to be a success it was necessary that the blood which escaped through the aorta before the operations could, after repair of the septal defect, arrive at the pulmonary capillaries by passing through the main pulmonary artery, its branches and divisions, the pulmonary capillary network, the pulmonary vein and the left auricle. Only in this manner can the cardiac function be normalized.

In our contribution we give all of our attention to the branches of the pulmonary artery and its divisions since the infundibulum and the arterial trunk have been well studied, from the anatomical point of view by numerous North American authors and European one have profoundly studied the infundibulum and the main pulmonary artery.

In this paper we will study the existing relation between the diameter of the pulmonary artery and of its branches with the intensity of the levo-angio-cardiogram in 63 cases of Tetralogy of Fallot with extra-cardiac shunts which were operated on by the surgeons Angel Giral and Robert Fojo.

More recently, we have studied these data in 156 cases[4] many of which have not been surgically treated as yet. Another work on the diameter of the pulmonary artery and their branches in diseased children, without congenitals or adquired diseases, have been written[5]. Besides, in addition, the same studies were carried out in normal children, completely healthy, actually living, by means of the convencional intravenous angio-cardiography[6].

In our Paper we emphasize that in addition to the diameter of the infundibulum and the pulmonary artery trunk, the diameter of the branches and their divisions must be considered. This juggement is based on the fact demonstrated by the cardiac contrastograph in cases of Tetralogy which had accentuated hypoplasia or very intense branches and whose branches had no contrast in levo and in case of making the repair of the interventricular defect no

important quantity of blood could reach the lung making the operation a failure.

The angio cardiography permits us to know in a sufficiently exact manner the quantity of blood that the pulmonary artery passes to the pulmonary circulation and which is returned to the left cavities to be distributed by the systemic circulation.

Making the injection of contrast matter in a peripheral vein and obtaining a series of plates during several seconds, one can see if there is what we have named levo-cardiogram, that is, contrast of the left auricle, the left ventricle and the aorta. When there is well contrasted levo-angio-cardiogram, it means that the pre-operative pulmonary flow is relatively large or sub-normal and therefore, when cardiac reconstruction is practiced there will not exist an acute or sub-acute pulmonary heart which developes every time that reconstruction is carried out in cases of generalized hypoplasia of the pulmonary trunk and its branches. These latter cases do not have a levo-angio-cardiogram.

We have demonstrated that one can have more certainly in the levo-angio-cardiogram than in the hemo-dynamic estimate to appreciate the pulmonary flow, for which we publish the following comparative table:

BLOOD VOLUME CC PER MINUTE

Clinical No.	*Levo Intensity*	*Systemic flow*	*Pulmonary flow*	*R-L shunt*	*L-R shunt*
1492	++++	11,660	3,300	9,643	1,343
257	+	4,030	2,310	1,710	0
716	++++	2,490	1,897	1,170	1,319
294	0	6,260	1,980	4,280	0
113	0	2,870	1,500	1,310	0
84	+++	3,456	1,987	1,469	0
38	+	2,440	1,087	1,353	0
311	+	3,860	1,708	2,250	1,665
131	?	14,530	1,215	13,315	0
110	0	7,292	2,318	4,911	1,366
68	?	3,590	1,280	2,320	4,040
16	?	3,390	1,950	1,440	0
55	++++	8,250	5,668	5,385	2,800
34	++++	7,120	9,290	1,090	3,260

Actually, the third case in the table, N° 716, with a very intense levo-angio-cardiogram has only 1,897 cc/mm/, N°. 55, on the other hand with an intense levo has 5,668 cc/mm/, Nos. 294 and 113 which have no opacification of the left cavities in the levo, have 1,980 and 1,500 cc/mm/ respectivelyá Case N° 84 which has a very contrasted levo has only 1,987 cc/m.

The relation between the systemic flow and the pulmonary flow has no value either. Case N° 1,492 which has a very intense levo has a relationship of systemic flow to the pulmonary flow of 3.5 to 1. On the other hand, N° 34 has a relationship of 1 to 0.75. The same relationship occurs in those cases which do not have contrast in the levo-angio-cardiogram as we will illustrate. Case N° 294 has the relationship of 3.1 to 1, while case N° 113 has 1.8 to 1.

If we were to obtain some conclusion it would be the following: In cases with a very intense levo the relationship between systemic flow and pulmonary flow is very changeable; and without any value whatsoever in cases which have no contrast between the left cavities, the pulmonary flow will seem to be greater than what one logically expects. Actually, if the pulmonary circulation is reduced to half, that is, if the systemic flow is double the pulmonary flow a little more or less than half of the radio-opaque matter injected should reach the pulmonary circulation; if this were certain a moderate or light contrast of the left cavities would be obtained. In the cases studied there was no contrast of these cavities, which signifies that not even a quarter part of the contrast matter arrived in them.

Neither is there a relationship between the shunts of right to left and left to right and the intensity of the levo. Case N° 294 has no levo and there is no left to right shunt; case N° 84 has a very intense levo and there is no estimated shunt in this direction either.

DEVELOPMENT OF THE PULMONARY ARTERY AND ITS BRANCHES IN 156 CASES OF TETRALOGY OF FALLOT

It is impossible to make a criticism of the surgical treatment of this anomaly is one does not know well the anatomicals conditions of the structures which determine the success or the failure of such treatment. For that reasons 156 cases have been studied from this point of view.

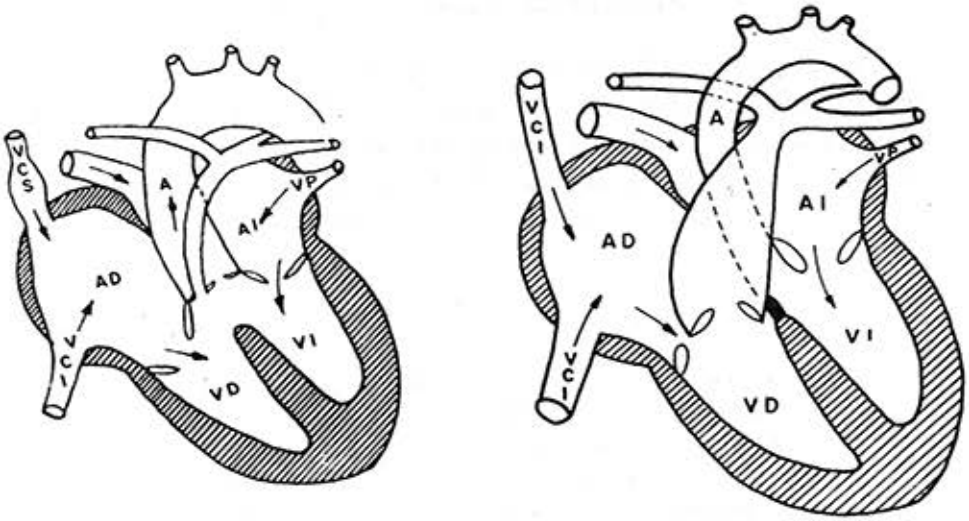

FIG. 1.—Left: Tetralogy of Fallot with severe hypoplasia of the main pulmonary artery and its branches. Before complete repair with open heart. Right: After the surgical correction. Even with corrected infundibulum or main pulmonary artery the branches of pulmonary artery are very narrow and they can not admits the amount of blood needed. Example of the so-called *"residual pulmonary stenosis"*.

The exact clasifications of so many cases is very difficult and surely various investigators will not come to an unanimous agreement, since a great number of variations exist. We pointed out in a recent paper and proved that there exist at least 27 anatomical combinations[10] only between the trunk and the branches without taking into account the pulmonary veins, the left auricle or the infundibulum.

	Cases
Intense hypoplasia of the P.A. trunk and branches	58
Moderate hypoplasia of the P.A. trunk and branches	70
Intense hypoplasia of the P.A. trunk and right branch with left branch normal	1
Intense hypoplasia of the P.A. trunk and right branch with left branch very dilated	3
Intense hypoplasia of the trunk and less hypoplasia of the two branches	6
Light hypoplasia of the trunk and left branch with the right branch dilated	6
Moderate hypoplasia of the trunk and right branch with the left branch very hypoplastic	1
P. A. trunk slightly dilated with normal branches	1
Agenesia of right branch	1
Deficient angios	4
	156

In our opinion the intensity of the levo-angiocardiogram is in very close correlation with the pulmonary blood flow and which the volume of blood that the lung may receive when the V.S.D. is closed in complete repair. For that reason we have studied the intensity of the levo in 156 cases of Tetralogy of Fallot:

Levo	*Number of cases*	*Porcentaje*
No levo	51	32.68
Slight.	15	9.62
Medium	31	19.88
Intense	29	18.60
Deficient(*).	30	19.22

(*) Wrong radiologicals factor or not enough numbers of plates for knowing whether there is or not levo-angiocardiogram.

Pulmonary circulation time in Tetralogy of Fallot.—From a theorical point of view one could think that the development of the pulmonary branches and capillaries could be anticipated knowing this time. If this time is normal one could deduct that these structures are normals. If this time is retarded it should correspond to undeveloped pulmonary vessels. In order to determine if this exploration is useful or not in this way we studied the pulmonary circulation time in cases with intense and slight levo-angiocardiograms.

Three methods were used: 1) The determination of the time between the early filling of the right ventricle and that of the left auricle; 2) Estimating the maximal radiological density of the left auricle; 3) By determining the lapse between the entrance and exit of the contrast media in the left auricle

In our case the pulmonary circulation time has been determined by estimating the time that the contrast delays in traveling from the pulmonary arterial trunk and its branches in the left auricle.

CIRCULATION TIME IN CASES WITH INTENSE LEVO-ANGIOCARDIOGRAM

Name	*Age*	*Weight (kilos)*	*Height (cms)*	*Duration (seconds)*
RGL	3 mo.	2.9	50	2
AHM	4 mo.	5.5	61	1½
SCJ	5 mo.	6.7	64	2
AGJ	6 mo.	5	61	1½
RC	9 mo.	6.1	69	1½
ARR	1 yr.	7	72	2
LLJM	15 mo.	9	74	2
PPN	2 yr.	10	82	2½
GPJN	2 yr.	14	88	2
GRLE	2½ yr.	9	85	2½
MCVR	2½ yr.	10.5	85	2
MFN	3 yr.	11.3	85	2½
RVA	3 yr.	11	88	2
CMC	3 yr.	15.5	102	2
PSJ	4 yr.	15.8	101	2
TCM	5 yr.	17	107	?
MMM	5 yr.	18.5	113	2½
SMJ	7 yr.	24	124	2
PMC	7 yr.	19	115	3½
LTJ	8 yr.	18.3	117	2
PPH	8 yr.	23.5	128	3
SFM	10 yr.	25	129	2½

CIRCULATION TIME FROM R. V. TO L. A. IN CASES WHICH HAVE A LIGHT LEVO-ANGIO-CARDIOGRAM

Name	*Age*	*Weight (kilos)*	*Height (cms)*	*Duration (seconds)*
PCM	6 mo.	7.5	62	1
PCM	—	?	?	1½ (1)
LLJM	15 mo.	9	74	2
BC	20 mo.	9.5	79	2½
CHRN	2 yr.	12	86	3
CGJ	2½ yr.	10	84	2½
AJR	2½ yr.	14	93	2
AJR	—	?	?	4 (2)
FRR	3 yr.	15	95	4
CSJ	3½ yr.	13	98	2½
GPJ	4 yr.	16	98	2½
RMJ	4 yr.	11	91	3
PBS	5 yr	11	64	2½
MCN	8 yr.	23	122	2½

(1) Operated; new examination.

(2) There is no error in the reading. The second angio was made one year after the first one.

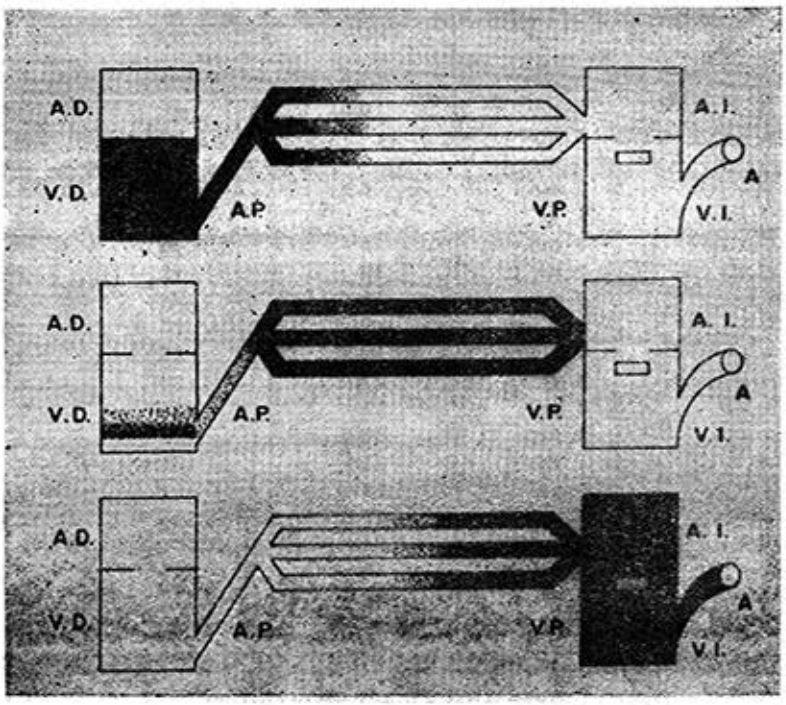

FIG. 2.—Upper: Dextro-angio-cardiogram. Medium: capillary phase. Low: Levo-angio-cardiogram.

We arrives at the conclusion that the time of pulmonary circulation measured by this method is almost equal in the two groups of cases and in turn these two groups are indistinguishable from normal cases.

What we have noticed is that the time required for the disappearance of the contrast is longer than normal. Also we will say in passing that in isolated pulmonary stenosis with a pressure near 80 mm of Hg. in the right ventricle as well as in inter-ventricular septal defects and typical Eisenmenger complexes in early stage this time of pulmonary circulation is also within the normal limits.

The anatomical state of the pulmonary veins and the left auricle has been very little studied in this anomaly. It is probable that all cases which have a great lessening in the pulmonary flow

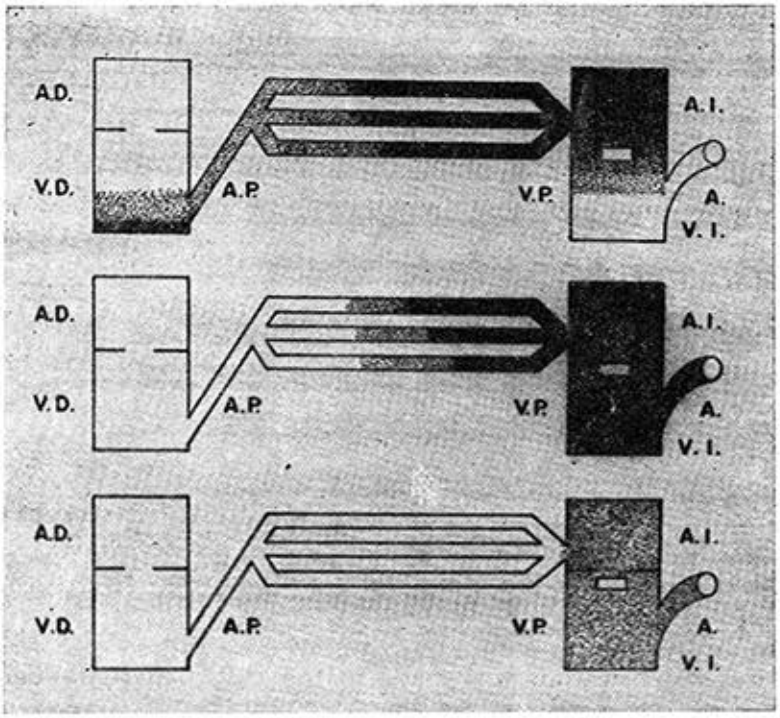

FIG. 3.—Pulmonary circulation time estimated by angiocardiography. Upper: Determination of the time taken by contrast media for arriving to left auricle. Medium: Determination on the maximun of the radiological contrast of the left auricle. Low: The time taken since the early radio-opacification until the dissappearence of the dye of the left auricle is another point of view for this study.

have very hypoplastic pulmonary veins and an auricle of more or less decreased size. This condition has great importance, because even though by the operation of Lillihei one would correct the outflow tract of the right ventricle, the trunk of the artery, and its two branches; the existence of very hypoplastic pulmonary veins and left auricle causes an acute or sub-acute cardiac insufficiency. We have the good fortune to present a case which we know to be unique in medical literature. It is a tetralogy in which an angio was made from a frontal position and an intense hypoplasia of the pulmonary artery trunk and its branches was observed with a lack of contrast in the left cavities in the levo phase.

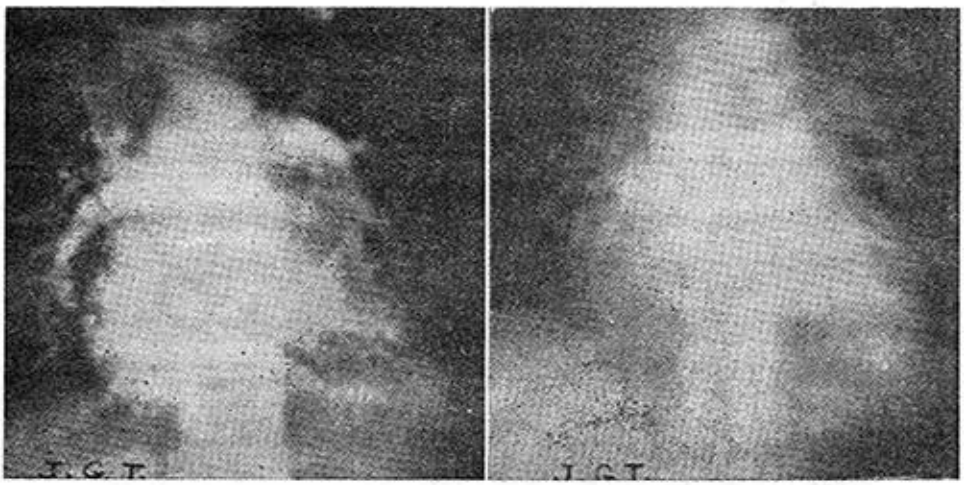

FIG. 4.—Tetralogy of Fallot. Left: Simultaneous filling of the aorta and main pulmonary artery and its branches. Right: 2 second later Normal levo-angiocardiogram, Good pulmonary blood flow.

First the injection was made in the right side and the right superior cave was seen to be normal. The injection was repeated in the left side and then one left cave terminated in the left auricle. It is important to point out that in two plates the image of this auricle was well seen, in both, the left auricle was noted to be very atrophic and even the pulmonary veins, which were retrogradely opaque, were also seen to be very hypoplastic. The operation of this case, carried out by Dr. Giral, consisted in joining the anormal vessel and an extra-cardiac derivation. The heart reconstruction would have determined the death of the patient because the pulmonary vein and the left auricle could not hold nor handle the blood that could arrive at the pulmonary capilary network after the operation supposing that hypoplasis of the two pulmonary artery branches had occured.

When there is a normal, medium or even light levo-angiocardiogram it is easy to appraise the development, number, situation, etc., of the pulmonary veins and of the left auricle. But when it is necessary to learn these details in cases which have a negative levo the evaluation is not so easy. In these negative levo cases,

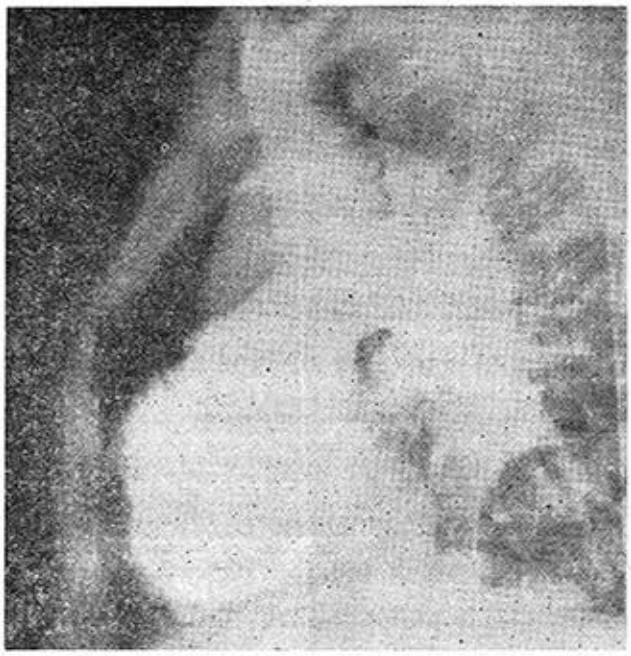

FIG. 5.—Tetralogy of Fallot. Confirmed by cardiac catheterization. Lateral view: Simultaneous filling of the aorta and main pulmonary artery and its branches. This trunk and its left branche have a diameter wider than normal.

when the cardiac cathetering is done it is possible to pass from the rigth auricle to the left by forcing the foramen ovalis as well as by the existence of a true defect in the atrial septum. The selective injection inside the left auricle permits one to visualize filling the cavity clearly and if it is done with great rapidity, it is even possible to achieve the retrograde of some pulmonary veins.

Dr. Gross speaks rightly about the existence of two classes of patients having tetralogy, the "pink" patients and the "blue" ones. He says that the "pink" patients are almost always candidates for reconstruction while the "blue" ones usually are candidates for extra-cardiac derivation.

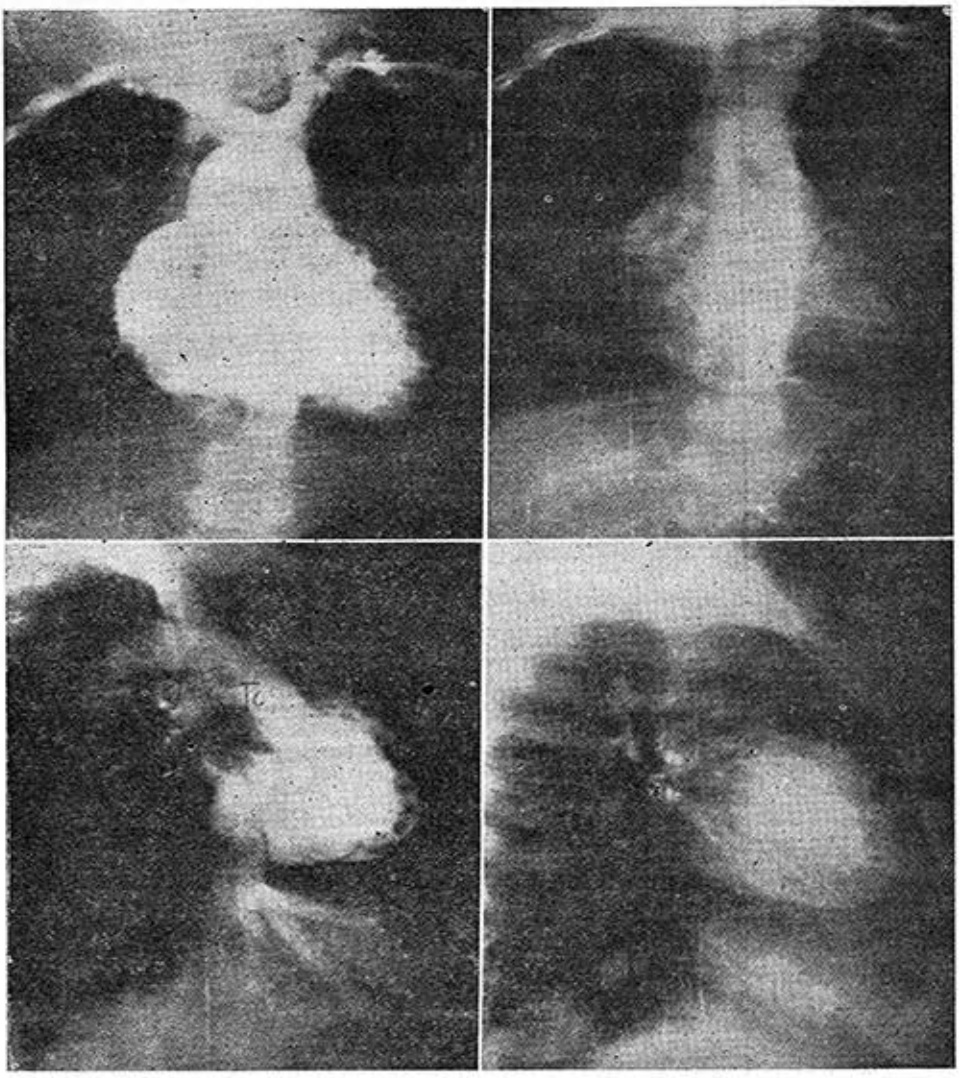

FIG. 6.—Tetralogy of Fallot with severe hypoplasia of the main pulmonary artery and its branches. Upper left: Dextroangiocardiogram in frontal projection. Upper right: levoangiocardiogram whithout late opacification of the left cardiac chambers. Lower left: Lateral projections. Dextroangiocardiogram. Main pulmonary artery very hypoplastic. Lower right: Levoangiocardiogram without radio-opacification of the left cardiac cavities.

For this reason we have shown the relationship between the intensity of the levo-angio-cardiogram with the clinical cyanosis.

The results, for patients with an intense levo, are tabulated below:

Series No.	*Age*	*Cyanosis*	*Levo Intensity*
7	7 yrs.	+++	Intense
21	3 yrs.	?	Intense
28	9 mo.	?	Intense
29	14 yrs.	+	Intense
32	1 yrs.	++	Intense
38	4 yrs.	+	Intense
50	11 yrs.	++	Intense
55	4 yrs.	++	Intense
68	4 yrs.	+	Intense
76	2 yrs.	++	Intense
79	6 yrs.	+	Intense
84	3 yrs.	++	Intense
87	2 yrs.	+	Intense
89	6 mo.	++	Intense
92	2 yrs.	+++	Intense
97	7 yrs.	++	Intense
98	5 mo.	++	Intense
101	3 yrs.	++	Intense
108	2 yrs.	?	Very Int.
139	1 yrs.	?	Intense
146	5 yrs.	+	Intense
151	11 yrs.	++	Intense
155	1 mo.	+	Intense

We have not shown the intensity of the levo with arterial saturation taken in the moment of cathetering, because in many cases, in children, the anaesthesia produces a respiratory depression and gives a low cifer. If the same is done apart from the catheterism a little or no anaesthesia, the complaint of the patient modifies the cifer. On the other hand we do not use the oximeter with an auricular piece which would be very useful in giving more exact cifers.

We will now show the relationship between clinical cyanosis and the intensity of the levo in cases which have no radio opacification of the left cavities in the levo phase. This study shows that the majority had a very intense cyanosis.

Series No.	*Age*	*Cyanosis*	*Levo Intensity*
22	3 yrs.	++++	None
26	7 yrs.	+++	None
30	7 yrs.	+	None
36	25 yrs.	++++	None
47	5 yrs.	+	None
51	8 yrs.	++++	None
52	1 yrs.	+++	None
54	5 yrs.	+++	None
58	2 yrs.	++++	None
67	2 yrs.	+	None
86	2 yrs.	+++	None
90	2 yrs.	++++	None
102	3 yrs.	++++	None
104	5 yrs.	+++	None
106	5 yrs.	+++	None
116	13 yrs.	+++	None
130	2 yrs.	+++	None
149	11 yrs.	+++	None

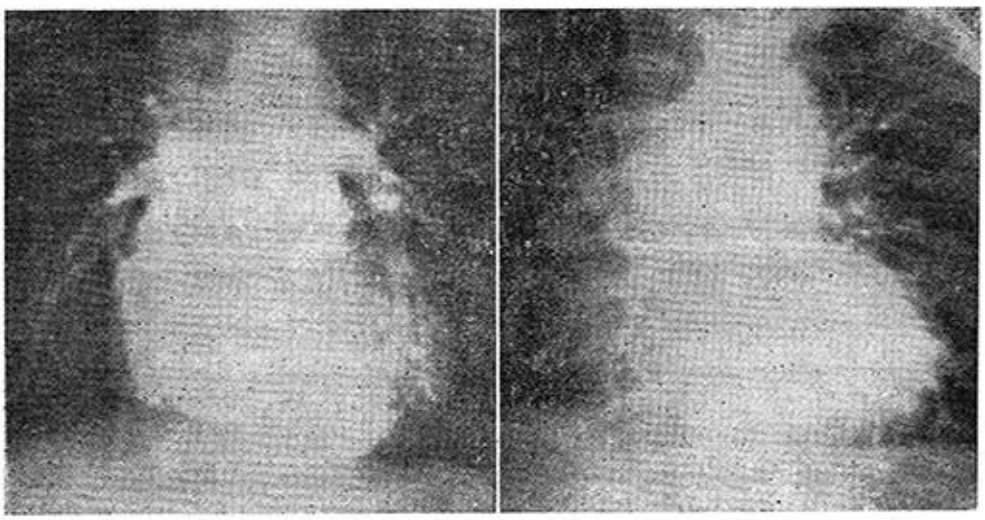

FIG. 7.—Tetralogy of Fallot. Frontal projection: Left: Simultaneous filling of the main pulmonary artery and the aorta. The diameter of this structures are almost normal. Valvular stenosis of the pulmonary artery. Right: Levo-angiocardiogram. Pulmonary veins very well contrasted. Left cardiac chambers and aorta with normal contrast.

It is well illustrated that the cases of intense levo have, in general, a cyanosis which is quite inferior to those which have no intense levo. This confirms Dr. Gross statements.

All these data force us to maintain the opinion that in the Tetralogies one must keep a liberal or broad and not rigid criterion.

One important aspect of the problem is the class of hospital or clinic service in which the cardiological work is developed. The experience of pediatric cardiologists is not the same as that which is acquired in a practice in which the majority of the patients are adolescent, children and adults.

The pediatrician and the surgeon who work in an infant hospital have distinct human material. They have a series of daily problems which those who attend adolescent children and adults do not have. The former have the opportunity to see children of a few weeks to a few months of age with Tetralogy, intensely cyanopathic and dyspnoeic with polycithemia with asphyxial crisis at the slightest effort, etc. These cases, on not being operated on, will die before they reach one year of age. All these patients, with rare exceptions, have general hypoplasia of the pulmonary trunk and its branches. It is difficult to maintain the criterion, that the cardiac reconstruction of Lillihei is indicated in these cases. We believe that all pediatricians and child surgeons are in agreement that the indicated correction is that of Potts and rarely that of Blalock. We have already explained the fundamentals of this method.

We do not wish at this time to relate the post operative course of the cases operated under the above criterion. There is already sufficient literature on this phase.

When the shunt is correct the child many times improves in a spectacular manner. When shunt is very great after a variable period of improvement, an aggravation of symptoms with cardiomegalia, dyspnoea, even in repose, etc. takes place.

When the operation has been well done, the majority continue to live many years and surely will continue many more years or all of their lives with a tolerable cardiopathy.

There is evidence that when everything has been correct, the extracardiac shunt amplifies the pulmonary artery and its branches. In a new paper to be published we have collected the cases of Tetralogy which were operated on at least seven years before and those in which angio-cardiographic studies were completed both before and

after the operation. The usual is an increase of the diameter of the arterial trunk and its branches.

An important report by Richard S. Ross, Helen B. Taussig and Melvyn H. Evans, reports 17 cases of Tetralogy operated with extra-cardiac shunts which had very ample anastomosis and as a result of this the cases developed a picture of cardiac insufficiency years after being operated. Four cases received the Potts method and thirteen the Taussig-Blalock method[11].

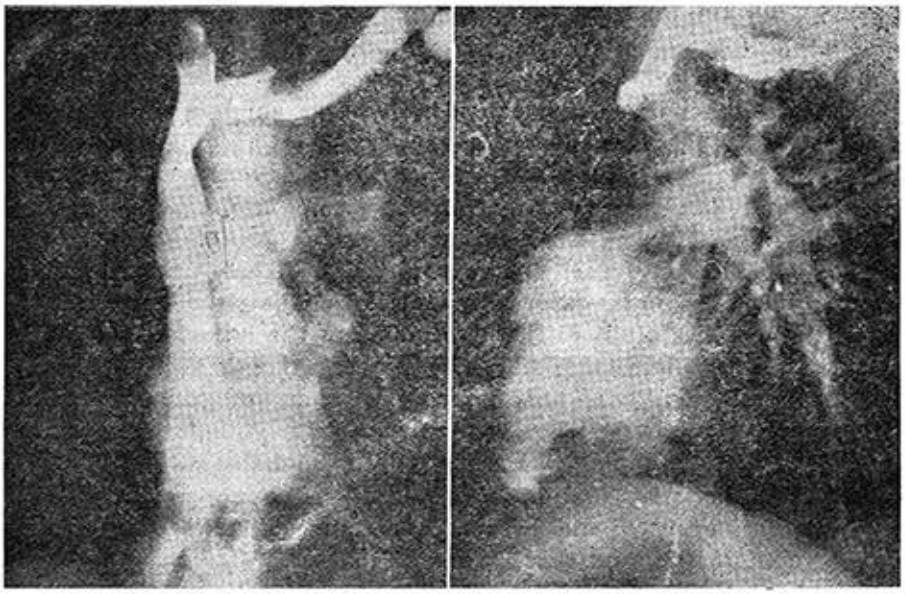

FIG. 8.—**Tetralogy of Fallot. Left: Frontal view: Stenosis of the main pulmonary artery above the valves. Right: Lateral view.**

In some cases there was an aneurismatic increase in the left pulmonary branch; in others an increase in the trunk forming a very projected mild arch. In all there was an increase in the cardio-thoracic index and a radiological increase in the pulmonary circulation. Unfortunately only in one case (with a very convex ½ arch) was cardiac catheterism done and the pulmonary arteries were found to have a 95% saturation with pulmonary pressure of 40/22 mm. of Hg.

It is certain that these 17 cases had a very ample surgical communication and that the excess of shunt was the cause of the hemodynamic complications although the hypothesis made by Dr. Taussig herself that there could previously exist a vascular alteration[12] of the pulmonary circulation from the moment that Europeans and North-Americans described tetralogies with relative pulmonary hypertension without operations of any kind, has not been eliminate[13].

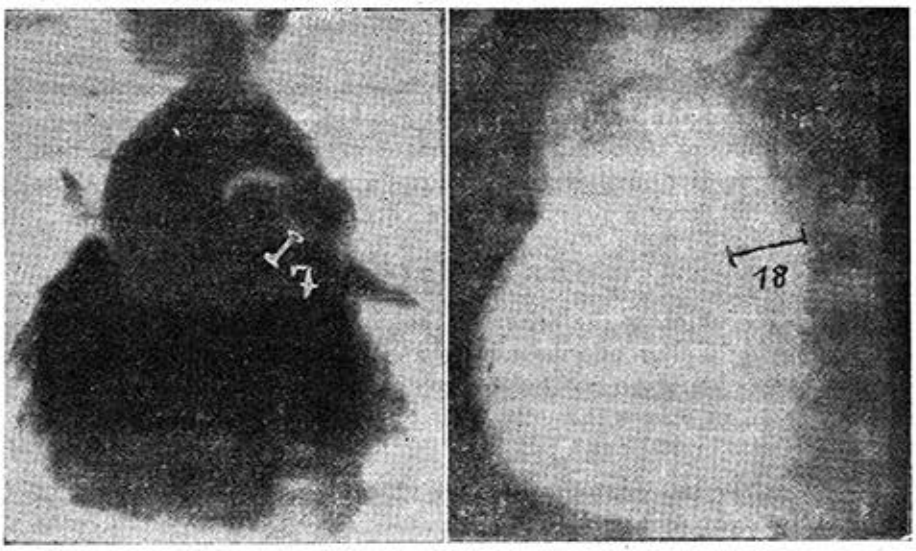

FIG. 9.—Tetralogy of Fallot. Frontal view. Dextroangiocardiogram. Left: Intense hypoplasia of the main pulmonary artery and its branches. The trunk has 7 mm of diameter. Right: 6 years later. Pott's operation was carried out. The main pulmonar artery has 18 mm of diameter, that is, almost three times that before the surgical correction.

It is possible that the diameter of the anastomosis was correct, but that the vascular network had anatomical changes which did not permit the blood from the shunt to pass. This corroborates the thesis exprounded by Dr. Gross, which is strengthened by us, that in some cases of tetralogy there can be unfavorable anatomical conditions.

That is to say, there can be cases with such great hypoplasia or so many vascular changes that they can not endure even the

best made shunt. This of course does not discard the explanation of a too ample anastomosis.

Even though the operation has been correct and in the absence of a demonstrable anatomical alteration of the pulmonary vessels, there is always an evident increase in the diameter of the artery and its branches. We present various illustraions in this paper proving this statement.

If the artery and its branches increase in size in the years following the operation, and surely including all the arteriole ramifications and the pulmonary venous system, then the patient is in the same position as one who congenitally has these structure almost normally developed. In these circunstances, the cardiac reconstruction of Lillihei can be well carried out.

We know of no sound or important argument which says that the reconstruction in these cases, causes a greater risk than in those which do not have a previous extra cardiac shunt.

CONCLUSIONS

1.—We maintain the criterion that in the surgical treatment of Tetralogy of Fallot one most have an eclectic criterion and while some cases should be treated by complete reconstruction with the heart open, in others the only remedy is to make an extra-cardiac shunt (Potts or Blalock).

2.—From the anatomical point of view cases of Tetralogy of Fallot for a complex of anomalies that affect the cardiac cavities, aorta, pulmonary artery and branches, arterioles, pulmonary veins and venas cavas.

3.—There are cases which have a moderate hypoplasia of the trunk of the pulmonary artery and its branches in which the pulmonary flow is sub-normal or slightly diminished. These cases generally have a light cyanosis at least in repose. There are the "pink" cases of Dr. Gross.

4.—Other cases have an intense hypoplasia of the trunk of the artery and its branches and likewise of the divisions of the branches, the pulmonary veins and the left auricle. These are the "blue" cases of Dr. Gross.

5.—Cases which have a sub-normal development of the pulmonary artery and its branches, with a little cyanosis in repose and a

relatively good functional tolerance, have a normal levo-angio-cardiogram.

6.—The cases with intense hypoplasia of the artery and its branches with intense cyanosis even in repose, have no levo-angio-cardiogram but they have a left auricle more or less diminished in size, and in some cases atresia.

7.—The anatomical study of the pulmonary artery branches, their divisions, the pulmonary veins and left auricle is very important in making an operative decision and also aiding this decision the study of the dextro and levo-angio-cardiogram have much importance while the determination of time of circulatory velocity of the pulmonary circulation has no value to the method utilized by the author.

8.—The study of the radio-opacification of the left cavities permits and always certain idea of the degree of pulmonary flow and in our hands this study has been more reliable than the hemodynamic estimate in many cases.

9.—It is necessary to intensify our knowledge of arterioles, capilaries and veins in this anomaly, since there exists the suspicion that many cases of Tetralogy have anatomical changes which make the extra-cardiac shunt as well as the complete reconstruction of little success.

10.—The cases of intense generalized hypoplasia of the pulmonary artery trunk and its branches which is accompanied by atresia of the pulmonary veins and of the left auricle, complete reconstruction must fail due to the fact that once the inter-ventricular communication has been closed the blood from the right ventricle can not reach the left cavities. In these cases, even when an infundibular hypoplasia should one exist, is supressed, the reconstruction has to end fatally. Only the extra-cardiac shunt can improve such patients.

11.—When the extra-cardiac shunt is well done; in the majority of cases it produces, in after years, an amplification of the pulmonary arterial branches and pulmonary venous branches, an increase of the left auricle, thus putting the patient in condition for a complete cure using the cardiac repair method with the heart open.

12.—In this work we do not mention the importance of the infundibulum to the fact that it has been well studied by surgeons, cardiologists and anatomists.

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