Pulmonary Artery Banding in Infants with Cardiac Anomalies Other Than Ventricular Septal Defects: Including an Evaluation of a New Technic for Determining a Critical Degree of Banding*

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INTRODUCTION

Since the original clinical report of Muller and Dammann in 1952,1 the use of pulmonary artery banding in small infants with congestive heart failure due to large ventricular septal defects has been widely recognized and used as a beneficial, palliative procedure of reasonable risk.2-4 Only limited clinical information is available concerning the use of banding in the treatment of other types of congenital heart disease associated with low vascular resistance and high pulmonary blood flow.5-7 Additionally, the immediate determination of the ideal or even an adequate degree of banding at the surgical table continues to be a serious problem in the uniform success of this procedure.

During the past four years, we have had experience with pulmonary banding in 14 infants with congenital heart disease other than ventricular septal defect and in ten of these infants have used a technic for pulmonary artery banding in which the end point of constriction was based on changes in pulmonary arterial and systemic arterial oxygen saturation. The results of banding of these infants and an evaluation of the accuracy of arterial saturation as an aid in the determination of a critical degree of banding are the subjects of this report.

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1. Patients—The 14 infants treated by pulmonary artery banding ranged in age from six weeks to eight months. There were five girls and nine boys. All were below the third percentile in weight. All patients had evidence of right- and left-sided cardiac decompensation and had been digitalized with digoxin (Lanoxin). All were severely ill and 12 of the 14 had marked dyspnea, auscultatory evidence of pulmonary edema and required continuous oxygen therapy. Operation was carried out as an emergency procedure in three patients and in four others on a semi-emergency basis. It was the opinion of all observers that these infants could not survive for more than a few weeks or months without surgical palliation. The indexed pulmonary blood flow in every case was greater than 15 liters per minute. Three had acyanotic congenital heart disease and 11 cyanotic congenital heart lesions. Of the latter group, two patients had large right-to-left shunts (greater than 40 per cent of the systemic flow) and nine had small right-to-left shunts (20 per cent or less of the systemic flow). The pulmonary systolic pressure was elevated to systemic levels in all except one patient; however, because of the high pulmonary blood flow, the calculated pulmonary vascular resistance was less than four units in all patients. There was markedly increased pulmonary venous admixture (evidenced by low pulmonary venous saturation) in three patients during unassisted 20 per cent oxygen breathing. Pulmonary artery banding was the planned procedure in ten of the 14

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TABLE I—CHRONOLOGIC EXPERIENCE AND RESULTS OF PULMONARY ARTERY BANDING IN INFANTS WITH PULMONARY PLETHORA DUE TO LESIONS OTHER THAN VENTRICULAR SEPTAL DEFECTS

<table>
<thead>
<tr>
<th>Case No.</th>
<th>Init.</th>
<th>Cardiac Lesion</th>
<th>Age (mos.)</th>
<th>Result</th>
<th>Per Cent Drop in PA Satur.</th>
<th>Murmur Change</th>
<th>Postoperative Necropsy Diameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>S.T.</td>
<td>Truncus</td>
<td>8</td>
<td>Expired</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>L.D.</td>
<td>Truncus</td>
<td>2</td>
<td>Expired</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>B.P.</td>
<td>Taussig-Bing</td>
<td>2</td>
<td>Expired</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>M.S.</td>
<td>Taussig-Bing (+PDA)</td>
<td>2</td>
<td>Improved</td>
<td>21* 2→4</td>
<td>&gt; &gt;</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>B.P.</td>
<td>Taussig-Bing</td>
<td>2</td>
<td>Improved**</td>
<td>20 1→3</td>
<td>&gt; &gt;</td>
<td>1/2</td>
</tr>
<tr>
<td>6</td>
<td>J.S.</td>
<td>Single Vent. (+T)</td>
<td>4</td>
<td>Improved</td>
<td>10 4→6</td>
<td>= =</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>R.M.</td>
<td>Single Vent. (+T+PDA)</td>
<td>7</td>
<td>Expired</td>
<td>6</td>
<td></td>
<td>1/3</td>
</tr>
<tr>
<td>8</td>
<td>M.H.</td>
<td>AV Com. (+PDA)</td>
<td>8</td>
<td>Expired</td>
<td>22</td>
<td></td>
<td>1/2.2</td>
</tr>
<tr>
<td>9</td>
<td>W.H.</td>
<td>T.A. (+ASD+VSD +T-Type 2C)</td>
<td>2</td>
<td>Expired</td>
<td></td>
<td></td>
<td>1/2</td>
</tr>
<tr>
<td>10</td>
<td>M.B.</td>
<td>AV Com.</td>
<td>5</td>
<td>Improved</td>
<td>40 3→4†</td>
<td>&gt; &gt;</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>S.B.</td>
<td>M.A. (+ASD +SV+T)</td>
<td>7</td>
<td>Improved</td>
<td>23 2→4</td>
<td>= =</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>T.B.</td>
<td>Single Vent.</td>
<td>5</td>
<td>No Change</td>
<td>5 2→2</td>
<td>= =</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>S.R.</td>
<td>T.A. (+ASD+VSD –Type 1C)</td>
<td>2</td>
<td>Improved**</td>
<td>18 2→4</td>
<td>&gt; &gt;</td>
<td>1/2.2</td>
</tr>
<tr>
<td>14</td>
<td>D.E.</td>
<td>AV Com.</td>
<td>3</td>
<td>Improved</td>
<td>7 3+4**</td>
<td>= =</td>
<td></td>
</tr>
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</table>

*SA saturation; **Late deaths due to pneumonia (Case 5) and infundibular obstruction (Case 13). †Pre-op at LLSC—Postop at ULSB.

Legend: ——No change; >—Decrease; MA—Mitril atresia; TA—Tricuspid atresia; AV Com.—Atrioventricular communis; PA—Pulmonary artery; PDA—Patent ductus arteriosus; T—Transposition; ASD—Atrial septal defect; VSD—Ventricular septal defect; SV—Single ventricle; CTD—Cardiac transverse diameter; PVM—Pulmonary vascular markings; SA—Systemic artery.

PULMONARY ARTERY BANDING

TABLE 2—PATIENT SELECTION FOR PULMONARY ARTERY BANDING—SUMMARY OF CLINICAL, PHYSIOLOGIC AND ANATOMIC CRITERIA

Clinical—Failure to thrive, congestive heart failure with moderate to marked dyspnea.

Chest Roentgenogram—Cardiac enlargement 3 to 4+, pulmonary vascular markings increased 3 to 4+.

Physiology—Indexed pulmonary flow >15 L./min., pulmonary resistance <4 units, systemic arterial saturation >70 per cent, pulmonary systolic pressure equals approximately the systemic arterial pressure.

Anatomy—Lesion not amenable to surgical correction or surgical correction possible only at high risk.

patients. Banding was undertaken in two patients with truncus arteriosus after surgical exploration ruled out a ductus. Banding was performed in two other patients after exploration of the heart using cardiopulmonary bypass revealed that the cardiac anomalies could not be totally corrected. Table 1 lists the patients in the chronologic order of our experience. Two had truncus arteriosus (Collett and Edwards, type 1); three had the Taussig-Bing type transposition (reported previously); three, single ventricle; three, atroioventricular communis; two, tricuspid atresia (types 1c and 2c of Keith and associates) and one, mitral atresia. Table 2 summarizes the clinical, physiologic and anatomic criteria used in patient selection.

2. Banding Technic—A cotton umbilical tape was used for banding the first 11 patients, external plication was used in the twelfth patient, and Dacron bands were used in the last two patients. Changes in pulmonary arterial and systemic arterial oxygen saturation were used as indicators of a critical degree of banding in ten patients (Cases 4-14). Table 3 lists the changes in blood oxygen saturation following pulmonary artery banding which were used for determination of the "end-point" of pulmonary artery constriction. In patients with acyanotic congenital heart disease, an ideal "end-point" of banding would be to increase the pulmonary resistance to a level where pulmonary and sys-
Table 3—Changes in Blood Oxygen Saturation Following Pulmonary Artery Banding

<table>
<thead>
<tr>
<th>Degree of Banding Adequate</th>
<th>“Ideal”</th>
<th>Excess</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. Acyanotic Lesions</td>
<td>PA=SV</td>
<td>PA≈SV</td>
</tr>
<tr>
<td>II. Cyanotic Lesions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A. Large L→R</td>
<td>+</td>
<td>PA&gt;15-30%</td>
</tr>
<tr>
<td>Small R→L</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B. Large L→R</td>
<td>+</td>
<td>SA&gt;to no less than 50%</td>
</tr>
<tr>
<td>Large R→L</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Legend: PA—Pulmonary arterial saturation; SV—Systemic venous saturation; SA—Systemic arterial saturation; L→R—Left-to-right shunt; R→L—Right-to-left shunt; >—Decrease.

Temic blood flow were equal. At this point, pulmonary artery oxygen saturation would just equal systemic venous saturation. A decrease in pulmonary artery saturation to a level only 5 to 10 per cent greater than systemic venous saturation would indicate a residual but small left-to-right shunt and would result from banding which was adequate. Excess banding would be present when the pulmonary resistance exceeded the systemic and would be evinced by decrease in systemic arterial saturation due to right-to-left shunting. These criteria are not applicable to patients with complicated heart lesions associated with bidirectional shunts, since the pulmonary artery saturation in such patients is always greater than the systemic venous saturation. In patients with large left-to-right shunts and small right-to-left shunts, it was felt that the magnitude of drop in pulmonary arterial oxygen saturation following banding would reflect the magnitude of decrease in pulmonary blood flow. Figure 1 illustrates the calculated changes in indexed pulmonary blood flow for changes in pulmonary artery saturation at two levels of pulmonary venous saturation. Since the relationship of pulmonary artery saturation to pulmonary blood flow is a parabolic curve (Fig. 1), the change in pulmonary blood flow is large in association with initial small changes in saturation. Therefore, it seemed apparent that a decrease in pulmonary artery oxygen saturation of approximately 20 per cent would be associated with a marked reduction in pulmonary blood flow and could be used as an index of adequate banding. The band was loosened if the drop in saturation was in excess of 30 per cent and the banding increased if the difference was less than 15 per cent. It is important to remember that the calculated changes in flow illustrated in Fig. 1 assume that blood oxygen capacity, oxygen consumption, systemic blood flow and pulmonary venous saturation are all constant. We cannot be certain that all of these parameters remained constant in our patients. Blood oxygen capacity should not change unless there is excessive bleeding or transfusion. It seems unlikely that oxygen consumption changed significantly over the sampling period. If the systemic
blood flow decreased, a given decrease in pulmonary artery saturation would represent a lesser decrease in pulmonary flow and the converse if the systemic flow increased. It is quite possible that pulmonary venous saturation increased following banding in patients with large left-to-right shunts since pulmonary congestion is often relieved by the procedure. If this occurred, a given drop in pulmonary artery saturation would represent a greater decrease in pulmonary flow. In patients with large right-to-left shunts as well as left-to-right shunts, we felt that it was more critical to obscure changes in systemic arterial saturation as the pulmonary artery was banded so as not to lower the systemic arterial saturation below 50 per cent; since in patients with bidirectoinal shunts, the systemic arterial saturation falls as the pulmonary blood flow is decreased. If banding is planned for a patient who has a systemic arterial saturation below 70 per cent, we feel that it is desirable that banding be performed in conjunction with a second procedure to increase systemic and pulmonary venous mixing.

Patients with acyanotic lesions and patients with small right-to-left shunts were ventilated with 20 per cent oxygen for five minutes prior to banding. Patients with large right-to-left shunts were allowed to breathe 60 to 100 per cent oxygen during banding since systemic arterial saturation increased only slightly in these patients during high tension oxygen breathing and surgery was tolerated poorly at lower oxygen tensions. A pulmonary arterial sample or systemic arterial sample was then withdrawn and the banding performed. The blood oxygen saturation was determined by the indirect spectrophotometric method of Gordy and Drabkin,\textsuperscript{a} which requires only one to two minutes for a determination, and could, therefore, be completed while the banding was accomplished. The surgeon produced pulmonary artery banding estimated to reduce the pulmonary artery diameter to one-half to one-third that of the aorta (area of one-fourth to one-ninth that of the aorta). He was guided in this initial effort by gross observations of myocardial color and action. The electrocardiograph was monitored constantly during the procedure. The band was promptly loosened when any significant bradycardia occurred. The banding tape was then clamped and a second pulmonary or systemic arterial sample withdrawn. This second sample was analyzed for oxygen saturation while the surgeon sutured the band. If the difference in saturation between the first and second samples was 15 to 30 per cent, the procedure was concluded. The band was loosened if the change in saturation was in excess of 30 per cent and the band tightened if the saturation difference was less than 15 per cent.

In patient 6, only a 10 per cent decrease in saturation was observed even though the band appeared to result in a pulmonary diameter one-third of the aortic diameter. Cardiac action weakened following further banding. It is possible that pulmonary venous saturation increased in this patient. Her postoperative clinical findings and course indicate that the degree of banding is close to ideal. In patient 7, even after the surgeon felt the pulmonary artery was almost completely occluded, the saturation drop was less than 10 per cent. At necropsy, this patient proved to have a large missed patent ductus arteriosus and pulmonary artery banding without ligation of the ductus probably did not result in a significant decrease in pulmonary blood flow. In patient 12, the decrease in pulmonary artery diameter was accomplished by the plication technic and resulted in only a five per cent decrease in saturation. It was not technically possible to increase further the pulmonary artery narrowing in this patient. In patient 10, the initial change was 50 per cent; however, cardiac action was good. The band was slightly loosened and the second sample showed a 40 per cent change. The band was not further altered since gross observation indicated that the band was well tolerated. This previously acyanotic patient has grad-
Clinical Results (Table 4)

Patients with acyanotic congenital heart disease: Three patients with large atrioventricular communis defects had pulmonary artery banding. Two patients survived and are clinically improved; however, both continue to have considerable cardiac enlargement and improvement has not been as marked as is usually seen after successful banding of patients with ventricular septal defect. Both surviving patients have shown less evidence of congestive heart failure following banding and both have begun to gain weight slowly.

Patients with cyanotic congenital heart disease: Large left-to-right shunts, small right-to-left shunts — Nine patients with this type cyanotic congenital heart disease have been banded. Four survived the surgical procedure and three evinced clinical improvement. The three patients who were improved showed changes comparable to the banded patients with atrioventricularis communis lesions. Patient 6 who had a single ventricle and transposition of the great vessels showed the most marked change. Preoperative and postoperative roentgenograms of this patient are illustrated in Fig. 2.

Large left-to-right shunts, large right-to-left shunts: Two patients were banded
who had lesions with both large right-to-left as well as left-to-right shunts. Both of these patients had the Taussig-Bing type transposition of the great vessels. Both survived and both were moderately improved by the banding. Patient 4 is now three-and-one-half years old, weighs 22 pounds and by chest roentgenogram shows only slight cardiac enlargement and normal pulmonary vascular markings. Patient 5 expired 18 months after surgery from bronchopneumonia.

An Evaluation of Arterial Oxygen Saturation as an Index of Critical Banding (Table 5)

Arterial oxygen saturation studies were performed in 14 cases. Our experience, although limited, has shown that change in arterial oxygen saturation can be simply and rapidly performed and that this information is a helpful adjunct for the determination of an adequate degree of banding. In six of ten patients, the saturation data indicated that the banding significantly reduced pulmonary flow. Five of these six patients survived surgery and the postoperative clinical findings indicated that pulmonary flow was significantly diminished. Two patients (5 and 13) expired five and 18 months postoperatively from other complications and necropsy observations showed the pulmonary artery to be banded to a diameter approximately one-half of the aortic diameter. One baby (Case 8) did not survive the banding procedure although saturation data indicated that there was adequate banding. This was a mongoloid infant with an atrioventricular communis who had had excessive bleeding in association with the pulmonary artery dissection for both ductus division and banding. Necropsy examination showed adequate banding.

In four infants, saturation data indicated that the banding had not resulted in a significant decrease in pulmonary blood flow. This proved to be the case in two patients. In one patient (Case 7), the band was quite tight, but the pulmonary flow was probably not diminished since a large ductus arteriosus was present. In another (Case 12), the plication technic had been used and it was not technically possible to achieve safely further banding. In Case 14, cardiac action weakened following banding which was associated with a drop in saturation of only 7 per cent. Postoperative clinical assessment indicates that pulmonary flow is decreased but it is still large. In the fourth patient (patient 6), efforts to increase the degree of banding, following only a 10 per cent drop in saturation, resulted in weak heart action and, therefore, the degree of banding was not increased. Postoperative observation indicated that the banding in this patient was adequate. We suspect that the pulmonary venous saturation in the last two patients increased significantly following banding.

Discussion

Most previous investigators have determined the adequacy of pulmonary artery banding by gross observations of cardiac action or by measurements of the right ventricular to pulmonary artery systolic pressure gradient. The gross technic has the advantage of keeping the operative time to a minimum which is certainly important in these severely ill infants. We felt that results would be improved if a quick reliable measurement could be used to confirm the gross observations. The pressure gradient technics as described by Morrow and Braunwald and Albert et al. apparently give quite consistent results, but are

<table>
<thead>
<tr>
<th>Table 5</th>
<th>Accuracy of Changes in Blood Oxygen Saturation as an Indicator of Pulmonary Artery Banding</th>
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<tbody>
<tr>
<td>No.</td>
<td>Survived Surgery</td>
</tr>
<tr>
<td>1. Saturation data indicative of adequate banding</td>
<td>6</td>
</tr>
<tr>
<td>2. Saturation data not indicative of adequate banding</td>
<td>4</td>
</tr>
</tbody>
</table>
not particularly simple or brief or atraumatic and do not necessarily indicate a decrease in pulmonary blood flow. We decided to use the technic described involving measurement of pulmonary arterial and systemic arterial saturation for the following reasons: (1) simplicity, (2) rapidity and (3) the change in pulmonary arterial oxygen saturation reflects changes in pulmonary blood flow when there is no significant change in blood oxygen capacity, oxygen consumption, pulmonary venous saturation or systemic flow. Because the accuracy of this technic depends on the constancy of variables which cannot be simply or accurately measured, its use must be limited to that of an adjunct in the assessment of adequate banding. As is seen in Table 5, the saturation data correlated with the adequacy of the banding in eight of ten patients. There were two false negatives; that is, patients (Cases 6 and 14) who proved to have adequate banding in whom the saturation change indicated an insufficient degree of banding. There were no false positives; e.g., a significant drop in saturation without a sufficient degree of banding.

The mortality of 43 per cent is high; however, it must be remembered that the criteria for patient selection for operation was the demonstration of large left-to-right shunts in small, extremely ill infants whose clinical condition indicated that survival beyond a few weeks or months was unlikely without surgical palliation. Our experience and that reported by Keith show that the expected natural attrition rate of such infants is greater than 80 per cent. Of the nine patients (Cases 4, 5, 8, 10, 11, 12, 13 and 14) in whom we felt satisfactory banding was accomplished, eight survived and seven (78 per cent) were clinically improved. It is our impression that surgical experience had more to do with the success or failure of the procedure in our patients than did the type of congenital heart defect, patient selection or other factors, since the first three patients of our experience did not survive and additionally two other patients who expired had had excessive bleeding during dissection of the pulmonary artery. The sixth death was probably the result of a faulty preoperative diagnosis. This was a patient (Case 7) with single ventricle in whom the diagnosis of a coexistent large patent ductus arteriosus had been missed. Because of our experience with this latter patient, we feel that it is imperative that exact knowledge of great vessel anatomy and the presence or absence of a significant size ductus be determined and, therefore, now routinely do aortograms as a part of the preoperative workup.

We did not measure changes in pulmonary artery pressure at the time of surgery in any of our patients. There was necropsy evidence of adequate banding in six patients. Postoperative catheterization has been performed in only one patient. His pre-banding pulmonary-to-systemic flow ratio was five to one. The post-banding ratio was one to one and there was a 60 mm Hg systolic gradient across the band (Case 13).

There is controversy as to the effect of pulmonary artery banding on patients with atrial communications. Morrow and Braunwald have stated that patients with atrial septal defect should not be banded since the magnitude of shunting will decrease only when right ventricular failure is produced. The experimental animal work of deS Amorim, et al. in animals with atrial defects has shown that banding is associated with marked reductions in the magnitude of left-to-right shunting with only minor changes in the right ventricular filling pressure. Young has recently stated that, "Because it appears that the additional presence of pulmonary stenosis has a beneficial effect on the complete form of atrioventricular canal, it seems reasonable to propose that banding the pulmonary artery . . . might be an effective, at least temporizing, surgical procedure . . ." Our experience with three patients with atrioventricularis communis lesions and the clinical experience of Dammann, et al. indicates that infants with large atrial left-
to-right shunts and communis lesions can be improved by pulmonary artery banding.

A few technical aspects of the surgical procedure merit mention. Based on our experience, we feel that the sternal splitting incision is the approach of choice except in patients who have associated patent ductus arteriosus. In these latter patients, a left anterior incision is preferred so that the ductus can be more easily divided prior to banding the pulmonary artery. Dissection of the pulmonary artery should also be done with great care in order to avoid excessive bleeding. Blind dissection through the "avascular" space is not indicated since there may be considerable bleeding from rupture of the large venous trunks which course close to the base of the pulmonary artery. We feel that use of the synthetic material, such as Dacron for the band, is preferable to cotton, since cotton bands seem to stretch during the first week after placement. The band width should not exceed 1 cm. as it is technically more difficult to control the amount of increased resistance with a wide band. We are at present experimenting with a Dacron band of belt type design. Use of such a band will allow the surgeon to assess more accurately the degree of banding since the diameter and hence the area of the banded segment would be known more precisely. By use of this type of band, it will also be possible to make small adjustments with greater precision.

**Summary**

1. Experience with pulmonary artery banding in 14 very ill infants with cyanotic and acyanotic congenital heart disease other than ventricular septal defect, reveals that this procedure resulted in effective palliation in 78 per cent (seven of nine) patients in whom satisfactory banding was achieved.

2. Evaluation of change in pulmonary arterial and systemic arterial oxygen saturation before and after banding proved to be a safe, simple and rapid adjunct for determining critical banding and correlat-
vias état, avec cardiopathie congénitale cyanogène ou sans cyanose autre que la communication interventriculaire, montre que ce procédé a amené un effet palliatif dans 78 pour cent (7 sur 9) des malades chez lequel l'opération a été fait de manière satisfaisante.

2. Une évaluation des modifications dans la saturation artérielle oxygénée artérielle pulmonaire et systématique, avant et après l'opération s'est montré être un test sûr, simple et rapide pour déterminer l'importance à donner au geste opératoire. Ces modifications ont une bonne corrélation avec le résultat post-opératoire sur l'efficacité du "banding" dans 8 malades sur 10.

3. Nos constatations suggèrent que le pourcentage de survie et l'efficacité du "banding" sont sans doute plus en rapport avec l'expérience des chirurgiens qu'avec la sélection ou le type de la cardiopathie congénitale, étant donné que nos trois premiers essais opératoires ont été infructueux et que deux des trois morts ultérieures sont survenues chez des malades qui avaient eu des complications chirurgicales.

4. Notre expérience montre qu'il est très important que les examens pré-opératoires comprennent une évaluation soigneuse de l'état anatomique vasculaire, pour qu'on soit aussi bien renseigné que possible sur la position exacte des grands vaisseaux, et la présence ou l'absence d'un canal artériel.

ZUSAMMENFASSUNG

1. Erfahrungen mit der Pulmonalarterien-Verpflanzung bei 14 kranken Kleinkindern mit Cyanose und ohne Cyanose bei angeborenen Herzfehlern, abgesehen von Kammernseptumdefekten ergab, daß dieses Vorgehen zu einer wirksamen Besserung in 78% führte (7 von 9), sofern eine befriedigende Vereinigung gelang war.

2. Eine Auswertung der Veränderungen in der pulmonalarterien-Sauerstoffsättigung und der Sauerstoffsättigung im großen Kreislauf vor und nach der Überpflanzung erwies sich als eine sichere, einfache und schnelle Methode zur Bestimmung kritischer Phasen der Vereinigung und stimmt sehr gut mit der postoperativen Auswertung einer ausreichenden Vereinigung in 8 von 10 Fällen überein.


4. Unsere Erfahrungen weisen darauf hin, daß es recht wichtig ist, daß präoperative Laborationsuntersuchungen auch eine sorgfältige Ermittlung der Anatomie der großen Gefäße einschließen, um so sicher als irgend möglich zu sein-hinsichtlich der exakten Lage der großen Gefäße und dem Vorliegen oder Fehlen eines ductus arteriosus von signifikantem Durchmesser.

REFERENCES


6 Thompson, W. W., Muller, W. H. and Dammann, J. F.: "Analysis of Clinical Results from the Surgical Creation of Pulmonary Stenosis in 35 Patients with Large Intracardiac Communications," Circulation, 18:789, 1958 (Abs.).


ANOMALOUS LEFT CORONARY ARTERY

Nine cases of anomalous origin of the left coronary artery from the pulmonary trunk, involving patients ranging in age from two months to seven years, have been reviewed. In six, mitral insufficiency was a prominent feature and, in three of these patients, mitral insufficiency presented the major problem clinically. The clinical picture was that of an acyanotic patient with nonspecific respiratory complaints and retardation of growth. In five patients, there were symptoms (although a presenting complaint in only one) which are considered classic for this anomaly. These symptoms included episodes of pallor, dyspnea, and perspiration. Eight patients experienced cardiac failure in infancy and response to digitalis was effective in each.

The vectorcardiogram in the horizontal plane was most helpful in the diagnosis of anomalous origin of the left coronary from the pulmonary trunk. The QRS vector loop in the horizontal plane in this anomaly was oriented posteriorly to the left and its direction was clockwise, in contrast to the counterclockwise direction of the loop in endocardial fibroelastosis.

Selective ascending aortography or selective right coronary arteriography established the diagnosis in seven cases.

TOBACCO ALLERGY IN CORONARY ARTERY DISEASE

That tobacco hypersensitivity is a factor in cardiovascular disorders in man is supported by the following observations: (1) exposure to tobacco may provoke symptoms in specific shock tissues, that is, the heart and coronary or peripheral vessels; (2) abstention from smoking causes clinical remissions in the functional and reversible reactions in these shock organs and may arrest the progress of diseases such as thromboangiitis obliterans, angina pectoris, and so on; (3) positive skin reactions are correlated with suspected clinical allergy; (4) reagents specific for various types of tobacco are demonstrable by passive-transfer tests.

MUCOID IMPACTION OF THE BRONCHI

Mucoid impaction of the bronchi is a syndrome occurring almost exclusively in asthmatics. These patients secrete a peculiarly viscid mucus, inspissation of which leads to bronchial occlusion and atelectasis, followed in some cases by suppuration and bronchiectasis. The radiologic features are described and three illustrative cases reported.