REPAIR OF TOTAL ANOMALOUS PULMONARY VENOUS DRAINAGE IN INFANCY

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Most patients with total anomalous pulmonary venous drainage into the right atrium via a “left superior vena cava” die in the first year of life. It follows that surgical treatment of this condition should be applicable to the infant. The purpose of this report is to describe and illustrate a technical method of repair which has been successfully performed in very small patients.

TECHNIQUE OF OPERATION

Operation is carried out through a mid-line, sternum-splitting incision. Excellent exposure of the heart is obtained as illustrated in Fig. 1, and routine cannulation of both venae cavae through the right atrial wall is performed. It seems particularly important to have a large cannula in the superior vena cava and avoid positioning this cannula above the junction of the innominate veins. A heavy ligature is passed about the “persistent left superior vena cava,” usually from within the pericardium, although in some instances it is easier to isolate this vessel extrapericardially. A femoral artery cannula is used for arterial return from the pump oxygenator. Total cardiopulmonary bypass is established and the apex of the heart is lifted out of the pericardium and gently held by a retractor (Fig. 2). The pulmonary veins are visible beneath the posterior pericardium just behind the posterior surface of the left atrium. This exposure is illustrated in Fig. 2. Lengthy incisions are made in both the common pulmonary trunk and the left atrium. It is important to avoid placing the incision in the left atrial appendage, although usually the left lateral end of the incision extends onto the appendage for a short distance. Anastomosis between the two structures is carried out with the use of continuous fine silk sutures (5-0). When this anastomosis is complete, the heart is returned to the pericardial cavity and a longitudinal incision is made in the right atrium, anterior to the interatrial groove (Fig. 3). The previously performed anastomosis is visualized through the atrial septal defect and the size of the left atrium is assessed. The atrial septal defect can be simply closed,

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as illustrated in Fig. 3, with a continuous suture, or it can be enlarged and the left border sutured to the right atrial wall in order to enlarge the left atrium. This probably will not often be necessary. Following atrial closure, cardiopulmonary bypass is discontinued, and, if the heart action remains satisfactory, the ligature on the left superior cava is permanently tied. It may be wise to ligate this vessel at its junction with the left innominate vein to prevent a blind venous pocket. If the heart action is not satisfactory after discontinuing cardiopulmonary bypass, pressures are measured in the pulmonary vein, left atrium, and left ventricle. If there is no gradient between pulmonary vein and left atrium but atrial pressure is high, the caval ligature is removed. This has not been thought necessary in the present series.

RESULTS

This procedure has been performed in 4 infants—3, 4, 8, and 30 months of age. The 30-month-old child weighed 22 pounds at the time of operation. In each of the 4 infants times have been after operation cal result of 12 hours after ration. At aut

![Fig. 1.—The exposure obtained through a mid-line, anterior, sternum-splitting, thoracic incision. Tapes are placed about the venae cavae and the right atrial cannulation is routine. The origin of the persistent "left superior vena cava" can be visualized intrapericardially in most instances.]

![Fig. 2.—The of the posterior is excellent. Incisions is carried out as is other 2 infants improved altho surviving patient immediate post age after cardi]
each of the 4, the technical procedure has been uncomplicated and the perfusion times have been 60, 98, 40, and 70 minutes. The 8-month-old infant died 3 days after operation of extensive interstitial pnemonitis. At autopsy the anatomical result of operation appeared satisfactory. The 4-month-old patient died 12 hours after operation without ever establishing effective spontaneous respiration. At autopsy the left side of the heart appeared to be hypoplastic. The other 2 infants (3 and 30 months) have survived and are apparently greatly improved although neither has had catheterization study since operation. Both surviving patients had more difficulty with pulmonary complications in the immediate postoperative period than is usually seen in patients of comparable age after cardiac procedures.
results of surgical treatment of the innominate vein to the left atrium and Mustard, by means of anastomosis through the right atrium, have been modified.

Sen et al describe a posterior atrial septal defect ligation of the atrial septal defect by closed procedures remains quite surgical tech repair of the atrium to the left atrium with the use of the atrial septal defect.

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**SUMMARY**

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**DISCUSSION**

The anatomical types, classification, and treatment of total anomalous pulmonary venous drainage have been reviewed in several recent publications. The operation described in this communication is applicable to only one type of anomalous drainage, that is, via a "left superior vena cava." It may be pertinent to consider this lesion as a separate entity because the revision.
sults of surgical treatment reported to date are much inferior to the results of treatment of other physiologically similar defects.

Treatment of total anomalous pulmonary venous drainage via the left innominate vein by anastomosis of portions of the pulmonary venous system to the left atrium without cardiopulmonary bypass was reported by Muller and Mustard. Cooley reported the first successful total repair of this anomaly by means of cardiopulmonary bypass. He describes the performance of an anastomosis between the left atrium and common pulmonary veins by working through the right atrium and enlarged atrial septal defect. This technique has been modified by Shumacker to facilitate performance of the posterior anastomosis. Senning has reported complete repair of the supracardiac type of total anomalous pulmonary venous return in an older patient by the use of a posterior approach for anastomosis of the pulmonary veins and left atrium, ligation of the left superior vena cava, and closure of the atrial septal defect by closed procedure. The number of infants successfully treated to date remains quite small, perhaps an indication of the need to consider alternative surgical techniques. Recently, Mustard has again advocated a two-stage repair of this anomaly in infants. At the first stage, anastomosis of the left atrium to the common venous channel is performed from outside the heart with the use of cardiopulmonary bypass. At a later stage the left superior cava is ligated if necessary.

The procedure illustrated in this report seems to be technically simpler than the transatrial anastomosis and furthermore limits the intracardiac portion of the procedure. It is not a new operation but rather a modification of that utilized prior to the availability of cardiopulmonary bypass. Use of bypass allows alteration of the position of the heart to facilitate performance of a large posterior anastomosis. It seems likely that if this anastomosis is sufficiently large there should be no concern over left atrial size. Further experience should determine clearly the true incidence of hypoplastic left ventricle and should answer the question of whether pressure measurements can be used in making a decision regarding ligation of the persistent left superior cava at the initial or a subsequent operation.

**SUMMARY**

With the use of cardiopulmonary bypass, anastomosis of the common pulmonary veins to the left atrium can be performed via an extracardiac approach after which the atrial septum is repaired and the persistent left superior cava is ligated. This operation can be performed in infants and has, in the authors' experience, given a successful result in 2 of 4 patients.

**REFERENCES**


THE STUDY
MITRAL STE

A Ten Year Study

E. Karl Koiwai,
Clifford K. Miri

Since the first case was formed on J of the fate of the patients with mitral insufficiency who die within years after the operation, it is not certain that the procedure is effective. Muller, in his report of 100 cases of mitral insufficiency, noted that 2 patients died without evidence of mitral regurgitation. Bailey, Glove, et al., in their study of 60 patients with mitral insufficiency, found that 11 patients died within 1 year of the operation. Blalock, in his study of 100 patients with mitral insufficiency, noted that 11 patients died within 1 year of the operation. From the Hahneman College of Medicine, this study was supported by the National Heart Institute. Received for publication on [date].