Catheterization of the Pulmonary Artery in Transposition of the Great Arteries
A Simple Method

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SUMMARY
A simple method of catheterization of the pulmonary artery in transposition of the great arteries with the use of a "floppy wire" and "J wire" is described. The method can also be used to enter the aorta from the left ventricle in cases in which there is an interatrial communication.

Additional Indexing Words: Congenital heart disease Interatrial communication Fluoroscopy

To assess a patient with complete transposition of the great arteries (TGA) for corrective surgery, it is necessary to have accurate and complete physiologic data. Measurement of pressure and oxygen saturation in the pulmonary artery is essential in many cases. Difficulty in catheterization of the pulmonary artery in transposition of the great arteries has led to the development of several technics, all of which are associated with problems.

It is the purpose of this paper to present another method of catheterization of the pulmonary artery in transposition of the great arteries. In addition the method can be used to enter the aorta from the left ventricle in cases in which the great arteries are normally placed and there is an interatrial communication. In some children a direct arterial entry, which is not without complications, is avoided.

Methods
Description of Technic (Fig. 1)
Following a cutdown, a no. 5 or no. 6 Lehman catheter is inserted into the long saphenous vein just below its insertion into the femoral vein, or if necessary into the femoral vein itself. It is then passed under fluoroscopic guidance into the right atrium and across an atrial septal defect or patent foramen ovale into the left atrium and through the mitral valve into the left ventricle. The catheter is advanced into the apex of the ventricle. A floppy wire, as described by Rossi and Verdu, is passed through the catheter and made to form a 180° loop in the ventricle. The floppy wire is made from a standard safety spring guide (nos. 9225 and 9235*) by withdrawing the straight inner core wire so that an extremely flexible distal tip of 10 cm is obtained. The catheter is then advanced together with the wire or over it, so that the tip of the catheter is pointing toward the transposed pulmonary artery (or the aorta when the great arteries are normally placed). The wire is then withdrawn to straighten the loop and then advanced again, when it can usually be made to enter the transposed pulmonary artery or normally placed aorta. It is sometimes necessary to use a second catheter as the flexibility of catheters varies and in some an undesirable loop may form in the right atrium. Alternately, in some cases, a standard J wire (nos. 9336, 9337 or 9338*) is used to direct the tip of

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*U. S. Catheter and Instrument Corporation, Glen Falls, New York.
the catheter upward in the direction of the pulmonary artery. Once the vessel is entered, the wire is completely withdrawn and blood samples and pressure traces are obtained. The procedure has not significantly lengthened the usual fluoroscopic time of cardiac catheterization.

The Patients

Nine patients with transposition of the great arteries were studied by this technic at the Royal Alexandra Hospital for Children, Sydney, and the Royal Children's Hospital, Melbourne, from January to September 1969. Their ages ranged from 6 weeks to 4 years. Four were 6 months old or younger; one was 12 months, and the other four were between 2 and 4 years old.

In 14 other patients without transposition of the great arteries an attempt was made to catheterize the aorta from the left ventricle. Their ages ranged from 17 months to 10 years. Eight patients were less than 4 years old.

The malformations are shown in table 1.

Figure 1

Four spot films showing stages in the formation of the loop in the left ventricle and entry into pulmonary artery. (A, B, and C) Patient had an atrial septal defect. (D) Patient had transposition of the great arteries.
Table 1
The Cardiac Malformations in Which the Technic Has Been Used

<table>
<thead>
<tr>
<th>Malformations</th>
<th>Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transposition of the great arteries</td>
<td>9</td>
</tr>
<tr>
<td>Other malformations</td>
<td>14</td>
</tr>
<tr>
<td>Atrial septal defect (isolated)</td>
<td>6</td>
</tr>
<tr>
<td>VSD with ASD or PFO</td>
<td>5</td>
</tr>
<tr>
<td>Tetralogy of Fallot with ASD</td>
<td>2</td>
</tr>
<tr>
<td>Tricuspid atresia</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>23</td>
</tr>
</tbody>
</table>

Abbreviations: VSD = ventricular septal defect; ASD = atrial septal defect; PFO = patent foramen ovale.

Results
In the group of nine patients with transposition of the great arteries, the pulmonary artery was catheterized in seven. One of the other two patients was shown at angiocardiography and surgery to have a ventricular septal defect and an unusually anteriorly placed pulmonary artery. The appearance was suggestive of a double outlet right ventricle or Taussig-Bing malformation rather than a classical transposition of the great arteries. The second patient in whom there was failure to enter the pulmonary artery was the youngest of the group at 6 weeks of age, and had a patent foramen ovale as the only interatrial communication. In all cases in which success was achieved an atrial septal defect was present as a result of either a surgical procedure or a balloon septostomy.

In the children without transposition of the great arteries, the aorta was entered from the left ventricle in 13 of 14 attempts.

No complications were associated with the use of the guide wire technic.

The pressure tracings obtained were of adequate quality (fig. 2A).

Discussion
In the relatively small number of cases reported in this paper the technic has proved simple and effective in achieving entry into the great artery arising from the left ventricle when an interatrial communication was present.

Figure 2
(A) Pressure trace of withdrawal from pulmonary artery to left ventricle using a no. 6 Lehman catheter. (B) Pressure trace of withdrawal from pulmonary artery to left ventricle using a polyethylene coaxial flow guided catheter. The damped pressure trace is typical of this technic in our laboratory.
The two major methods of entry into the pulmonary artery in transposition of the great arteries have been the coaxial flow guided technic and the suprasternal puncture method. While the former has been consistently successful in the hands of its originators, we have only had limited success with it. Others have also found difficulty in achieving consistent success with the method. The additional advantages of the present method are the better quality and accuracy of the pressure records (fig. 2) and more satisfactory blood sampling than can be obtained through the polyethylene tubing used in the coaxial flow guided technic.

Direct puncture of the pulmonary artery has been reported to have a high rate of success. It is, however, traumatic and carries a potential risk of bleeding. Furthermore, in children, it requires a general anesthetic. For these reasons the method described here appears preferable.

Knowledge of pulmonary arterial pressure and an estimate of pulmonary blood flow and vascular resistance are important in the assessment of cases of transposition of the great arteries as to their suitability for “corrective” operation and determination of the chances for its success. The method of catheterization of the pulmonary artery described in this paper provides a simple, safe, and effective way of obtaining this information. In addition, it can be used to obtain aortic blood samples and pressures in cases of congenital heart disease in which there is an interatrial communication and the great arteries are normally placed, thus avoiding the need for arterial puncture.

Addendum

Since this report was submitted for publication the technic has been used successfully at the Royal Alexandra Hospital for Children to enter the pulmonary artery in four more cases of transposition of the great arteries. Two of these were babies aged 10 days and 4 weeks, respectively. The other two children, one 3 years and 10 months old and the other 6 years and 10 months old, were studied following surgical “correction” by the Mustard procedure.

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