We report the transcatheter closure of 6 ruptured sinus of Valsalva aneurysms (RSVAs) in 5 patients aged 18-51 years. The RSVAs extended into the right atrium in 3 patients, into the right ventricular outflow tract in one, and into the pulmonary artery in one. In all patients, the RSVAs were entered from the aorta, an arteriovenous loop was created, and the Amplatzer occluders were implanted using a venous approach. Six procedures were performed in 5 patients. Five Amplatzer duct occluders and 1 Amplatzer atrial septal occluder were implanted. In 1 patient who had a left RSV, after deployment of an Amplatzer duct occluder, ST-segment depression was observed on the ECG and the procedure was abandoned. In the other 4 patients, complete closure of the RSVAs was confirmed by color Doppler echocardiography. No complications were observed during 9-19 months of follow-up. Percutaneous closure of an RSVA is feasible and can be used as an alternative to surgery.

Key words: Catheterization. Congenital heart defects. Amplatzer.
the magnitude of left to right shunt. Traditional treatment is surgical excision and patch closure in cardiopulmonary bypass.\(^5\)

Percutaneous closure of ruptured sinus Valsalva aneurysm (RSVA) was first attempted by Cullen et al\(^6\) in 1994 using a Rashkind umbrella. Since then a few reports have been published with the use of different available closure devices.\(^7\)-\(^10\) We would like to share our experience in transcatheter closure of 6 RSVA in 5 patients.

METHODS

From March 2007 to January 2008 5 patients (mean age, 33.2 y) underwent transcatheter closure of RSVA. Their clinical data are presented in the Table. The observed symptoms were as follows: dyspnoea, orthopnea, chest pain, palpitations, and syncope. In 4 patients there was congenital RSVA. One of them (Table, patient 2) underwent surgical closure of RSVA one year before this procedure. Another patient (Table, 3) probably had iatrogenic RSVA, from left coronary sinus into the right pulmonary artery, after surgical tetralogy of Fallot (TOF) correction. In all patients the diagnosis was established after detailed clinical and echocardiographic examination. Angio 64 multislice computed tomography (CT) was also performed prior to the procedure for better visualization of location of the shunt and for measurements. All patients were informed about two methods of treatment—cardiosurgery and the relatively new option, transcatheter closure. All preferred transcatheter closure of RSVA and signed informed consent.

The procedures were carried out under general anesthesia with both fluoroscopy and transesophageal echocardiographic (TEE) guidance. After cannulation of the femoral artery and vein a 6F vascular sheath was introduced. Diagnostic catheterization was performed. Then the shunt was visualized during aortography with a Pigtail 6F catheter placed just above the aortic valve in right anterior oblique (30 degree), postero-anterior or left anterior oblique (70 degree) projection, depending on best visualization of shunt (Figure 1A). The diameter of the RSVA was assessed on the basis of angiography and CT (both were equal in each case). Then a right Judkins coronary catheter was introduced with the use of Terumo wire from the aorta through the ruptured sinus to the right atrium or pulmonary artery, and Terumo wire was exchanged for 0.035 inch/260 cm long Amplatz extrastiff guide wire. This wire was snared and taken out with Lasso (Microvena) introduced from the femoral vein (arteriovenous loop was created). Over the wire a 7 or 8 F transseptal AGA sheath (45 or 180 deg) was introduced from femoral vein through the ruptured sinus to the ascending aorta. Amplatzer Duct Occluder (ADO) or Amplatzer Atrial Septal Occluder (ASO) (both AGA Medical Corp., Plymouth, MN, USA) were applied. They were chosen according to RSVA morphology - equal or up to 5 mm larger than RVSA orifice diameter. Stability of the opened device was confirmed during “Minnesota wiggle” (gentle pulling and pushing of the delivery system). Once the position of the device was considered acceptable, ECG was analyzed and Amplatzer device was released. The TEE and aortography then repeated (Figures 1B and 2).

RESULTS

The procedures were successful in all cases, but finished in 4 patients. In and 18 y old female (Table, 3) with postsurgical left coronary sinus to pulmonary artery communication, after deployment of the device changes in ECG appeared (ST depression) and the device still connected with the delivery system was withdrawn. In patient number 4 (Table), 8/6 ADO was initially implanted, but went through the RSVA into RA. The procedure was started once again from the beginning and 6 mm ASO was implanted without complication. In another patient, after closure of recanalized postsurgical RSVA (Table, 2) the second defect was

### Table. Data of Patients and the Procedures

<table>
<thead>
<tr>
<th>Pt/sex</th>
<th>Age, y</th>
<th>Connection</th>
<th>Diameter, mm</th>
<th>NYHA Class</th>
<th>Device/Size, mm</th>
<th>QP/QS</th>
<th>Fluoroscopy, min</th>
<th>Follow-up, mo</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/M</td>
<td>51</td>
<td>RCS-RVOT</td>
<td>13</td>
<td>III</td>
<td>AD014/12</td>
<td>2,2</td>
<td>10</td>
<td>19</td>
</tr>
<tr>
<td>2/M</td>
<td>23</td>
<td>RCS-RA</td>
<td>5</td>
<td>III</td>
<td>AD010/8</td>
<td>2</td>
<td>16</td>
<td>18</td>
</tr>
<tr>
<td>3/F</td>
<td>18</td>
<td>LCS-PA</td>
<td>3,8</td>
<td>III</td>
<td>AD08/6(^*)</td>
<td>1,5</td>
<td>35</td>
<td>-</td>
</tr>
<tr>
<td>4/M</td>
<td>41</td>
<td>RCS-RA</td>
<td>6</td>
<td>II</td>
<td>ASO6</td>
<td>2,2</td>
<td>19</td>
<td>10</td>
</tr>
<tr>
<td>5/F</td>
<td>28</td>
<td>LCS-RA</td>
<td>6</td>
<td>II</td>
<td>AD08/6(^*)</td>
<td>1,7</td>
<td>17</td>
<td>9</td>
</tr>
</tbody>
</table>

\(^*\) Device withdrawn because of ECG changes.
recognized after closure of the first one. This second defect was closed with 10/8 mm ADO during another catheterization after 6 months, with good final result. After the procedure, patients received aspirin 3-5 mg/kg for 6 months. One complication was observed – arteriovenous fistula in the groin after the second procedure (Table, patient 2) which needed vascular surgical intervention. In
Transcatheter Closure of Ruptured Sinus Valsalva Aneurysms

Szkutnik M et al. Transcatheter Closure of Ruptured Sinus Valsalva Aneurysms was the only possible treatment with relatively low perioperative risk (mortality <2%) in the past. However, coils could be implanted only in cases of minor connections. The effectiveness and safety of ASO and ADO in transcatheter closure of RSVA and other undesirable vascular connections was confirmed previously. In case of RSVA when ADO has unstable position, application of ASO can be a better solution due to its bigger retention discs. Using transcatheter closure can avoid possible complications of medial sternotomy and cardiopulmonary bypass. Reduced pain for the patient, absence of surgical scar, shorter hospitalization and convalescence time are also important advantages. Transcatheter treatment may be especially useful in the case of recanalisation after previous surgical treatment, when the risk of reoperation is substantially higher. The limitation of the study is a short period of follow-up. Theoretically there exists the risk of repeated rupture of the sinus of Valsalva, because of the presence of abnormal tissue. On the other hand, epithelialization of the device can make surrounding tissue stronger. These questions remain unanswered; therefore, longer follow-up after such procedures is needed. In conclusion, percutaneous closure of ruptured sinus Valsalva aneurysm is a feasible procedure that can replace surgical treatment.

REFERENCES