Amplatzer devices are used for the percutaneous closure of ostium secundum atrial septal defects, muscular ventricular septal defects, and patent ductus arteriosus. However, very little experience has been gained in using these devices in infants under 1 year of age. Between January 2001 and January 2008, 22 symptomatic infants aged under 1 year underwent percutaneous treatment: three had an ostium secundum atrial septal defect, 15 had patent ductus arteriosus, and 4 had a muscular ventricular septal defect. All the procedures were completed successfully. No immediate or medium-term complications were observed. Closure of these types of defect using an Amplatzer device in infants under 1 year of age, who would otherwise require surgery, is a safe and effective procedure.

**Key words:** Atrial septal defect. Ventricular septal defect. Ductus arteriosus. Cardiac catheterization.

**INTRODUCTION**

Amplatzer devices are used in the percutaneous closure of ostium secundum atrial septal defects (OS-ASD), patent ductus arteriosus (PDA), and muscular ventricular septal defects (m-VSD). They are safe and entail little risk and this has led to their widespread use in adult and pediatric patients, but little is known of their use, effectiveness and safety in patients aged <1 year.

**METHODS**

We conducted a retrospective review of children aged <1 year diagnosed with OS-ASD, PDA, or m-VSD, who underwent percutaneous closure procedures in our hospital between January 2001 and January 2008. We did not treat children with perimembranous VSD because these devices entail a risk of complete atrioventricular block, as recently confirmed for ≤5% of patients.

For each defect type, we used the techniques described in the literature for older children and adults. In all patients, we used general anesthesia; in patients with OS-ASD or m-VSD we also used transesophageal echocardiography. The Fick method was used to calculate the Qp/Qs. We chose an appropriate device according to the defect diameter; in patients with OS-ASD, a sizing balloon was used to establish the stretched...
We observed no peripheral vascular complications attributable to surgery or administration of heparin and/or thrombolytic agents.

**DISCUSSION**

**Atrial Septal Defects**

Most children with OS-ASD have few symptoms and surgery is generally indicated at pre-school age, although some require earlier treatment. It is reported that OS-ASD tend to grow with time. The group of children susceptible to early treatment includes those at greatest risk of progressing to irreversible pulmonary hypertension.

For example, patient 1, with Down’s syndrome, presented severe pulmonary hypertension with AP/AO ratio=1. His pulmonary pressure was normal at 1 year post-procedure. In patient 2, repeated respiratory...
infections, failure to thrive or high Qp/Qs indicated the treatment. Patient 3 (Figure 1), with congenital complete atrioventricular block without indication for pacemaker, had moderate pulmonary hypertension with AP/AO systolic pressure ratio =0.73 during cardiac catheterization. At 6 months, echocardiography showed normal pulmonary pressure. These 3 patients had specific indications for OS-ASD closure and we opted for percutaneous treatment to avoid the inconveniences of surgery. In the only series published in this age-group, OS-ASD required closure with hybrid procedures in 21% of children; although our group is small, we have not needed to employ this technique.

During follow-up (mean, 18.7 months), we found no late atrial wall perforation. A review of this rare complication found it occurs ≤3 years post-procedure. Patient age or weight were not risk factors. Both mismatching defect and device diameters and anterosuperior defect location have been suggested as risk factors for late of perforation.12

**Persistent Ductus Arteriosus**

PDA closure was indicated in all four patients because of excessive pulmonary blood flow. In patients 5 and 8, Qp/Qs may have been overestimated due to incorrect blood sampling in the pulmonary artery; however, PDA diameters were 2.5 and 3.2 mm respectively. Patient 4 (Figure 2) was a 40 days old infant girl, with a non-obstructive total abnormal pulmonary veins drainage into coronary sinus and superior vena cava. During cardiac catheterization we found suprasystemic pulmonary hypertension (AP/AO systolic pressure ratio =1.15) and 1.6 mm

Figure 1. Closure of ostium secundum atrial septal defects (OS-ASD) (patient 3). A: OS-ASD closure with cutting-balloon. B: angiography via previously-deployed 7 Fr sheath, 13 mm device.

Figure 2. Closure of patent ductus arteriosus (PDA) (patient 4). A and B: device deployed; aortic angiography in posteroanterior projection with and without contrast. C: left oblique projection; note the parallel paths of the occluded ductus and the aorta.
patent ductus arteriosus; she presented clear clinical improvement following percutaneous duct closure and was operated days later; she evolved well and subsequent examinations showed normalization of pulmonary pressure. In this patient, we decided to use the ductal occluder although the muscular VSD device is considered preferable due to the risk of embolization caused by severe pulmonary hypertension. Despite this, we opted for the ductal occluder because its retention disc is smaller (5 vs 9 mm).

Our results in 15 children aged <1 year are similar to those published by Butera et al. who reported successful closure in 18 children aged <3 years with PDA treated with the same device.

We have found no aortic obstruction similar to that described in a girl of 2 years who required surgery to remove the device. We avoided this complication by using the smallest possible device and also by measuring gradients in the aorta before Amplatzer deployment. During follow-up we found no obstruction in the aortic arch or left pulmonary branch, potential complications given these children were so small. We had no using local vascular complications, despite using sheaths as large as 7 Fr Mullins sheaths in the femoral vein (patients 9 and 14).

Muscular Ventricular Septal Defects

In a series of 20 children aged <1 year, Diab et al. reported 30% needed a hybrid procedure. In our 4-patient series, none required this. Patient 22, a girl with type I truncus arteriosus, double VSD (one of them muscular apical), had neonatal pulmonary banding. We decided to close the apical m-VSD first because surgical m-VSD closure entails high morbidity and mortality, especially when the location is apical, and the surgical approach may need to be from the left ventricle, with the consequent damage to ventricular function.

Risk of Vascular Lesion

Amplatzer deployment sheaths require venous access and are commercialized by internal diameter size. The largest diameter we used was 7 Fr (patients 2, 3, 9, and 14). In patients with m-VSD...
(Figure 3), we used 6 Fr sheaths via the internal jugular vein. We believe possible vascular damage caused by such thick sheaths can be minimized by careful handling.

REFERENCES