Editorial

BALLOON PULMONARY VALVULOPLASTY EXPERIENCE IN INFANTS AND CHILDREN

Rubio and Limon Lason I described a nonsurgical technique for dilatation of pulmonary valve stenosis (PS) in 1954; Gruntzig modified the catheters and utilized them in renal and coronary vessels. However, the procedure was not popularized in pediatric cardiac valve lesions until Kan and associates utilized the balloon procedure in PS in 1982. Since then hundreds of balloon valvuloplasty procedures have been performed worldwide, not only for PS, but also for other stenotic cardiac valves. Our own experience in this field consists of over 270 procedures; this far exceeds the reported experience from anyone center in the world.

The technique of this procedure is very well described in the literature. In critical PS, we have described a new technique of gradational balloon dilatation when the infant's condition is precarious, due to hypoxemia and acidosis, often requiring ventilation and prostaglandin infusion during the procedure. Although balloon valvuloplasty indications are not clearly defined, it is generally agreed that the surgical indications for pulmonary valve commissurotomy are equally acceptable for balloon dilatation. At the present time a peak-to-peak systolic gradient of 50 mm Hg or more by cardiac catheterization or two-dimensional echo Doppler study, regardless of symptoms, is an indication for balloon pulmonary valvuloplasty - although valves with lower gradients have been dilated. In dysplastic pulmonary valves, an initial balloon dilatation attempt could be made, since there may be different degrees of dysplasia; valves with partial dysplasia and commissural fusion do respond to dilatation. Several groups have reported excellent immediate and also intermediate-term results of this procedure.

Our own results in 232 infants and children excluding technical failures and complex lesions revealed a reduction in mean pulmonary gradient from 97 ± 49 mm Hg to 22 ± 17 mm Hg immediately after the balloon dilatation (P < 0.001). Predilatation gradients ranged from 30 to 310 mm Hg, and postdilatation ranged from 0 to 175 mm Hg. One hundred and three of these patients were recatheterized at a mean period of 8 ± 3 months. The gradient ranged from 5 to 210 mm Hg with a mean of 32 ± 32; the 210 mm Hg gradient was recorded in a patient with a dysplastic valve. The remaining patients were followed by two-dimensional echo Doppler studies. There was a 75% to 100% mean gradient reduction in 54% of patients, with a 50% to 75% reduction in 35%. This means that a reduction in gradient of at least 50% was achieved in 89% of patients. In our series only 3% of patients showed less than 20% reduction in mean gradient due to technical difficulties, small-sized balloons, or dysplastic valves. Longterm two-dimensional echo Doppler follow-up also has shown the persistence of dilatation after balloon valvuloplasty.

The mechanism of valvuloplasty has been observed to be tearing of valve raphae at the fused commissures and tearing and avulsion of the valve leaflets.

The complications of this procedure are extremely low. Many groups have reported transient bradycardia, premature beats, and fall in systemic pressure at the time of balloon inflation. We have noted complete right bundle branch block in two patients and supraventricular tachycardia and ventricular tachycardia in another two patients, each with full recovery after cardioversion or chest massage. Balloon rupture was quite common, occurring in 50 patients during inflation and did not cause any ill effects. Intubation and ventilation were performed, mostly in newborns and infants, electively in 10 patients and in 4 as an emergency measure. Femoral vein thrombosis was found in 4 of 103 patients recatheterized. Mortality is extremely rare in pulmonary balloon valvuloplasty except in very sick newborns and infants with critical PS. There were two infant...
deaths during the procedure in our series. Blood transfusion, bundle branch block, mild as well as serious forms of arrhythmia, balloon rupture, and severe infundibular reaction requiring propranolol administration have been reported in the literature. Generally, balloon valvuloplasty of critical PS in infants has a higher complication rate than older children. Doppler-demonstrable, trivial-to-mild pulmonary regurgitation is very common following balloon dilatation of PS, but it is highly unlikely to cause any future problems.

For ideal results, balloons larger than 1.2 times the diameter of the pulmonary valve annulus but less than 1.4 times should be used. If a double-balloon technique is utilized, generally the combined diameter of the two balloons is 1.4 to 1.6, and sometimes two, times the annulus size. The advantages of this technique are: (1) smaller balloons cause less vessel trauma and are easier to manipulate; and (2) when the pulmonary valve annulus is too large to dilate with a single balloon, two balloons may be successful. However, the disadvantage is that the procedure becomes time-consuming.

We feel there is no added advantage in using a pressure gauge during balloon inflations for intraballoon pressure measurements. Balloons are inflated by the syringe until there is no waisting at the stenotic valve, with the inflation/deflation procedure generally lasting for 5 to 10 seconds. The presence of foramen ovale or small atrial septal defect is advantageous during inflation because of the venting effect; there is less fall in systemic arterial pressure.

In our series 25% of the patients had infundibular gradients soon after the dilatation, more commonly in older patients and those with severe PS. Some of these gradients reached over 100 mm Hg postballoon dilatation. Generally they regress within 6 to 12 months after successful valvuloplasty. Propranolol had no constant effect in improving the gradients.

Balloon dilatation of stenotic pulmonary valves in infants and children offers great promise in avoiding open heart surgery in the majority of patients, besides being safe and effective. It can be performed in very sick newborns and infants with critical PS. Gradational, sequential balloon dilatation and carefully controlled anesthesia with assisted ventilation may be required. Although partial dysplastic valves may respond to balloon dilatation, the technique has little value in the management of severely dysplastic valves. Satisfactory long-term results can be achieved in patients without dysplastic valves or in partial dysplasia, regardless of age at the time of balloon valvuloplasty.

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