

Detachment of the Anterior Leaflet of the Tricuspid Valve to Expose Perimembranous Ventricular Septal Defects

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Background. Detachment of the septal leaflet of the tricuspid valve has been described for better access to perimembranous ventricular septal defects. Detachment confined to the anterior leaflet is less known, although it provides a better exposure of the subaortic area and puts less jeopardy on the conduction tissues.

Methods. Data regarding 49 consecutive patients who had congenital perimembranous ventricular septal defect closure were retrospectively reviewed. Thirty-three patients (67%) underwent temporary detachment of the anterior leaflet of the tricuspid valve. The defect was closed with a Gore-Tex patch and a continuous suture. In 10 patients (29%), concomitant right ventricular outflow tract enlargement was performed. Follow-up was ob-

tained in every patient (median time, 11 months; range, 2 to 26 months).

Results. No early or late death occurred. Closure of the ventricular septal defect was complete, with no more than trivial residual jet leaks found in perioperative echocardiography. All patients were in sinus rhythm. The tricuspid valve never showed more than mild insufficiency after repair. No patient showed subaortic obstruction.

Conclusions. Detachment of the anterior leaflet of the tricuspid valve to expose the ventricular septal defect is a safe approach that allows rapid closure of the defect with a continuous suture and provides excellent results.

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Temporary detachment of the tricuspid valve (TV) from its annulus to improve vision in closure of perimembranous ventricular septal defects (pVSDs) was pioneered by Hudspeth and coworkers in 1962 [1]. Although several surgeons favored this technique throughout the years [2–5], there have been almost no descriptions on detachment of the anterior leaflet. Most surgeons detach the septal leaflet [5] as initially described or both the septal and the anterior leaflets [2, 4]. We have progressively moved away from the septal leaflet to detach the anterior leaflet only because of the superior view of the aortic annulus it provides. Here we report our experience with this approach.

Patients and Methods

Forty-nine consecutive children who underwent closure of a pVSD at the University Hospital Zurich were retrospectively reviewed. Among them, 33 patients (67%) underwent detachment of the anterior leaflet of the TV alone and were included in the study. Data are expressed as medians and range. Demographic and operative data are summarized in Table 1.

The diagnosis of pVSD was established with echocardiography in all patients. Twenty-seven children had nonrestrictive flow across the defect and underwent repair during the first year of life (median age, 5 months). Transesophageal echocardiography was obtained peri-

operatively in all patients weighting more than 5 kg. Transthoracic echocardiography was performed during the stay in the intensive care unit and 3 months after hospital discharge. TV insufficiency was graded as none or trivial, mild, moderate, or severe, according to standard measurements.

Operative Technique

Patients were all operated on using cardiopulmonary bypass between both venae cavae and the ascending aorta. The aorta was cross-clamped and cardioplegic arrest achieved by intermittent infusion of cold hypercalcemic blood into the aortic root. The right atrium was opened. If the borders of the pVSD could not be precisely delineated because of the tricuspid subvalvular apparatus, the anterior leaflet of the TV was detached from its annulus (Fig 1). At the beginning of the series, the incision was often extended to the adjoining part of the septal leaflet. Progressively, it was confined to the anterior leaflet. The borders of the defect were then easily identified. In a few patients, fine secondary or tertiary chords inserted on the superior border of the pVSD were resected. A Gore-Tex patch (W.L. Gore & Associates, Flagstaff, AZ) was tailored according to the morphology of the pVSD. Attention was paid so that the patch was no larger than the defect to avoid wrinkles. The patch was inserted with a continuous suture (Fig 2).

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Table 1. Demographic and Operative Data

	Median	Range	No.
Clinical data			
Age at operation	10 months	6 days–11 years	
Weight (kg)	6.3	3.0–37	
Follow-up	11 months	2–30 months	
Morphology of the ventricular septal defect			
Aligned			24
Malaligned: Fallot or DORV type			9
Operative data			
Isolated septal defects (n = 15)			
Cross-clamp time (min)	32	23–38	
Cardiopulmonary bypass time (min)	81	68–87	
With associated procedures (n = 18)			
Cross-clamp time (min)	44	27–135	
Cardiopulmonary bypass time (min)	105	58–339	
Associated procedures			
Pulmonary artery enlargement/commissurotomy			6
Right ventricular outflow tract enlargement			7
Aortic valve reconstruction			3
Resection of a subaortic membrane			2
Correction of interrupted aortic arch			1

DORV = double outlet right ventricle.

It was inserted first on the posterior limb of the septo-marginal band, starting at the point of insertion of the anterior papillary muscle. With the patch anchored on this part of the defect, it was possible to gently pull on it to precisely expose the most remote parts of the pVSD borders (especially the junction between the anterior limb of the septo-marginal band and the conal septum). Along the ventriculo-infundibular fold, the patch was often sandwiched in the reapproximation of the anterior leaflet to the annulus. The superior part of the anterior leaflet was then approximated with a resorbable continuous suture (Fig 3). During closure of the atrium, warm cardioplegia was given in the aortic root, the heart was deaired, and the aortic clamp was removed.

Results

There were no perioperative or late deaths. The operative and postoperative courses were uneventful in all pa-

tients. The septal defect was closed in all patients. Residual leaks were detected in 6 patients. In 5 of them, the jet was attributed to needle holes across the patch. The leak had disappeared 3 months later. In 1 patient the initial leak measured 1 mm in echocardiography and was still detectable at 3 months. No patient had more than mild TV insufficiency, as shown in Table 2. Subaortic obstruction did not occur. All patients were in sinus rhythm. Two patients showed a complete, and 2 a partial, right bundle branch block.

Comment

Closure of a pVSD is one of the most commonly performed procedures in congenital heart surgery. Various techniques have been described involving an approach through the right atrium or the right ventricle with good

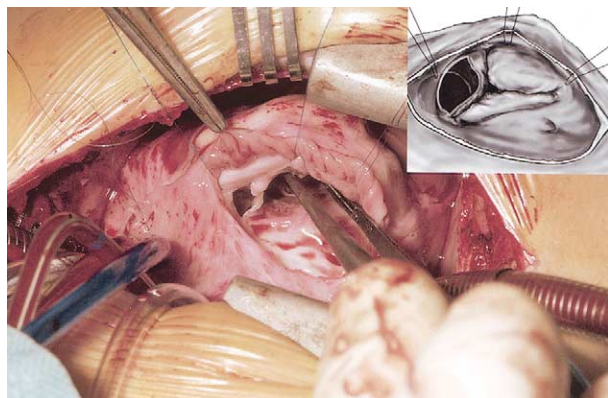


Fig 1. Detachment of the anterior leaflet of the tricuspid valve.

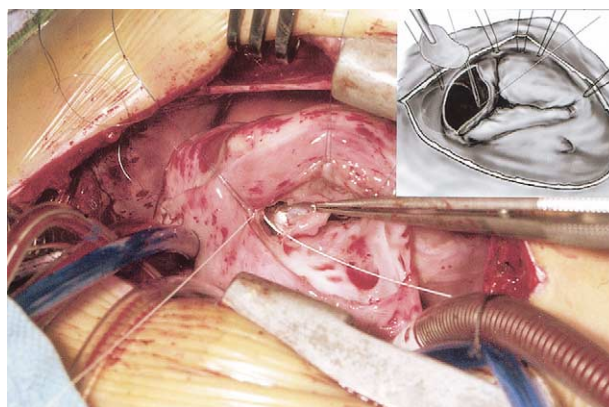


Fig 2. Insertion of the patch with a running suture. Note that the patch perfectly covers the defect.

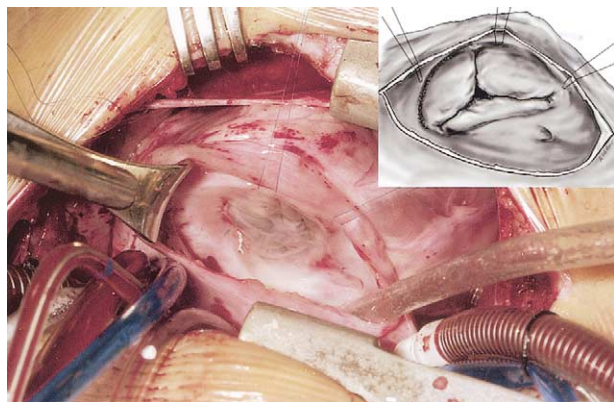


Fig 3. Readaptation of the anterior leaflet on its annulus. The valve competence is checked by injecting saline in the right ventricle.

results [1-6]. The goal of pVSD closure should not only be attaining separation of the both circulations, but should also consider the geometry of the heart and induce minimal trauma to the myocardium. A technique that minimizes myocardial damage, leads to an unobstructed outflow tract, and includes a short ischemic period presents obvious advantages, especially in cases where pVSD closure is only a part of a whole correction undertaken [7-9]. In these complex procedures, the additional ischemic and bypass time can only add to the overall morbidity.

The described approach derived from an original technique, where the septal leaflet was desinserted from the tricuspid annulus [1]. It became obvious to us that a pVSD could be appropriately exposed by detachment of only part of the anterior leaflet of the TV. The detachment provides a better exposure of the periaortic annular tissues at the expense of a reduced exposure to the posterior part of the pVSD. Attachment of the patch on this part of the septum has, in our experience, never been a problem, however. Furthermore, an injury to the conduction tissue during reapproximation of the TV seems less likely with this approach than after detachment of the septal leaflet.

We frequently perfuse the aortic root with cold blood under low pressure (between 10 and 20 mL/min) to insert the patch around the aortic annulus. This technique shows the exact relationship between the aortic annulus and the ventricular septum defect, a significant advantage in an overriding aorta. Indeed, it is easy to appropriately tailor the patch used for closure so that no interference with the function of the aortic valve later

occurs. We further usually anchor the patch on the myocardium folds around the aortic annulus (and not on the aortic annulus itself) to prevent a nonharmonious growth of the aortic annulus, which could potentially lead to the development of aortic insufficiency in the long term.

The function of the TV has not been disturbed by our approach. Our immediate echocardiography controls confirmed the good function of the TV with absence of more than mild, usually central, regurgitation. Good function of the TV is particularly important in tetralogy of Fallot if a pulmonary insufficiency or residual stenosis is anticipated.

Electrophysiologic studies have shown that the incidence and severity of arrhythmia were related to the amount of damaged myocardium [10]. This approach avoids an infundibulotomy, or limits it when enlargement of the right ventricular outflow tract is necessary. It is expected that the incidence of late ventricular arrhythmia will be reduced with this approach.

In summary, the approach of pVSD closure after detachment of the anterior leaflet of the TV provides a clear exposure of the defect through the right atrium for a rapid and safe closure. Studies in the long term should tell us whether the growth of the tricuspid valve is appropriate and if the incidence of arrhythmias is reduced.

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Table 2. Echocardiographic Evaluation for Tricuspid Valve Insufficiency

Preoperative	Postoperative	
	None-Trivial	Mild
None-trivial	21	2
Mild	8	2
Moderate-severe	0	0