

# Combined Tricuspid Valvuloplasty and Superior Cavopulmonary Anastomosis

for Repair of Traumatic Tricuspid Valve Injury

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*Chronic tricuspid valve insufficiency secondary to blunt chest trauma is rare in the pediatric population, with fewer than 10 cases reported. Surgical repair has focused on the tricuspid valve. We present 2 cases of traumatic tricuspid valve insufficiency in pediatric patients after blunt chest trauma in whom tricuspid valve repair was performed along with superior cavopulmonary anastomosis. To our knowledge, this is the 1st report of the use of this combination of surgical procedures for repair of traumatic tricuspid regurgitation in either adults or children. (Tex Heart Inst J 2004;31:418-20)*

**C**hronic tricuspid valve insufficiency secondary to blunt chest trauma is rare in the pediatric population, with fewer than 10 cases reported. Surgical repair has focused on the tricuspid valve alone. We present 2 pediatric cases of traumatic tricuspid valve insufficiency in which combined tricuspid valvuloplasty and superior cavopulmonary anastomosis were performed.

## Case Reports

### Patient 1

A 9-year-old boy suffered severe blunt trauma in a motor vehicle accident in October 1996. He had a cerebral contusion resulting in right hemiparesis, and he had multiple fractures of his extremities; however, he eventually recovered. Cardiac evaluation was performed after detection of a heart murmur in February 1999. Echocardiography demonstrated severe tricuspid valve regurgitation, severe right atrial dilation, and moderate right ventricular dilation with depressed systolic function. The tricuspid valve was thickened with incomplete coaptation of the leaflets. The cause of the tricuspid valve regurgitation was unclear, but it was presumed to be secondary to the motor vehicle accident. Because the patient was asymptomatic, surgery was not recommended at that time.

At a routine follow-up visit in February 2000, the patient reported progressive fatigue with exercise. Cardiac catheterization revealed grade 4+/4+ tricuspid regurgitation, severe right atrial and ventricular enlargement, and depressed right ventricular function. Frontal chest radiography showed severe cardiomegaly (Fig. 1). It was recommended that the patient undergo surgical repair.

Preoperative transesophageal echocardiography showed a severely dilated tricuspid valve annulus, moderate right atrial and ventricular dilation, and moderately depressed right ventricular function. Via median sternotomy, with the patient on cardiopulmonary bypass, the tricuspid valve was explored. The valve annulus was severely dilated, as was the right ventricle. Valve inspection revealed avulsion of the anterior papillary muscle with insufficient chordal support to the anterior leaflet. To achieve valvular competence, the flail leaflet was approximated to the adjacent commissures and annuloplasty was performed. Although competent, the valve appeared somewhat stenotic. Therefore, a superior cavopulmonary anastomosis was performed. After surgery, there was marked improvement in heart size as assessed by chest radiography (Fig. 2) and echocardiography. Forty-six months after surgery, the valve was not regurgitant or stenotic, and the patient continued to be active and asymptomatic.

**Key words:** Accidents, traffic; adolescent; child; chordae tendineae/injuries; heart injuries/etiology/surgery; human; tricuspid valve/injuries/surgery; tricuspid valve insufficiency/etiology/surgery; wounds, nonpenetrating/etiologies/complications/diagnosis

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**Fig. 1** Preoperative frontal chest radiograph shows severe cardiomegaly (Patient 1).



**Fig. 2** Six months postoperatively, frontal chest radiograph shows significant reduction in cardiomegaly (Patient 1).

### Patient 2

A previously healthy 14-year-old boy suffered severe blunt chest and abdominal trauma in June 2001. He had a liver laceration, head injury that caused permanent memory loss, and injury to the right eye that resulted in blindness. After the accident, he was evaluated for severe migraine headaches and was noted to have an abnormal electrocardiogram. Echocardiography revealed severe tricuspid valve insufficiency with a flail anterior leaflet and incomplete coaptation, as

well as severe right atrial and ventricular dilation. He was referred to our institution in June 2003 for surgical tricuspid valve repair.

Preoperative transesophageal echocardiography showed severe right atrial and ventricular dilation with hypokinesis of the right ventricular free wall and severe tricuspid regurgitation with incomplete coaptation of the tricuspid valve leaflets. Via median sternotomy, with the patient on cardiopulmonary bypass, the tricuspid valve was inspected. There were numerous ruptured chordae tendineae with a flail anterior leaflet and a severely dilated tricuspid valve annulus. We could identify no papillary muscles as corresponding to the flail chordae; therefore, the chordae were approximated to the endocardium of the right ventricular free wall. The anterior leaflet was plicated, and an annuloplasty ring was placed. Because repair of the tricuspid valve resulted in significant reduction in the tricuspid valve annulus, a superior cavopulmonary anastomosis was performed. The patient did well after surgery with minimal residual tricuspid regurgitation. The patient is asymptomatic, with a markedly increased level of activity. The valve remained competent 10 months after surgery.

### Discussion

Tricuspid valve insufficiency secondary to blunt chest trauma is uncommon but well described, with a wide range of presenting symptoms. The mechanism of injury appears to involve anteroposterior compression of the chest, resulting in a sudden increase in right ventricular pressure when the tricuspid valve is in the closed position.<sup>1,2</sup> The injury most frequently reported in adults is chordal rupture, followed by rupture of the anterior papillary muscle with tearing of the anterior leaflet. The clinical course of tricuspid regurgitation after blunt chest trauma varies from acute onset of severe symptoms to the insidious onset of fatigue, orthopnea, and dyspnea due to progressive right ventricular dysfunction.

Typically, the indication for surgical intervention after tricuspid valve injury by blunt chest trauma has been the onset of moderate-to-severe right heart failure. However, as the length of time after the injury increases, successful repair of the tricuspid valve is less easily accomplished. The difficulty in repairing the valve may be related to the progressive dilation of the tricuspid valve annulus, and to atrophy of the papillary muscles, chordae tendineae, and leaflets.<sup>2</sup> This would suggest that surgical repair should be undertaken before significant annular dilation and atrophy of chordae and papillary muscles can occur. Early repair would also prevent dilation of the right heart and preserve right ventricular function. Due to the difficulties associated with delayed repair of the tricuspid

valve, surgical intervention in adults frequently requires tricuspid valve replacement.<sup>2</sup> In children, size limitations and the high incidence of bioprosthetic failure make tricuspid valvuloplasty the treatment of choice.<sup>1</sup>

In both pediatric patients presented herein, tricuspid valvuloplasty was achieved with some annular reduction. In addition, we performed superior cavopulmonary anastomosis, because we believed that volume unloading of the right ventricle would provide additional hemodynamic benefit. To our knowledge, this combination of surgical procedures has not previously been reported in the English-language medical literature for repair of traumatic tricuspid regurgitation in either adults or children. However, the “one and one-half ventricle repair” (superior cavopulmonary anastomosis alone) has been used frequently in patients with pulmonary atresia, intact septum, and small right ventricle, in whom volume unloading of

the right ventricle was necessary.<sup>3</sup> We believe that the combined surgical approach is an effective method for repairing the tricuspid valve and volume unloading of the right ventricle, in order to preserve right ventricular function in patients in whom early diagnosis and repair was not achieved and in whom evidence of progressive right heart failure has developed.

## References

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