

## Avoiding the Pump in Tricuspid Valve Endocarditis— Vegetectomy under Inflow Occlusion

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**Background:** Surgical treatment of tricuspid valve endocarditis (TVE) ranges from vegetectomy to valve replacement with the use of cardiopulmonary bypass (CPB), accompanied by risks of systemic and lung complications. We present our experience with tricuspid valve vegetectomy under inflow occlusion without CPB.

**Methods:** Between July 1998 and July 2001, seven patients with a mean age of 26 years underwent tricuspid valve vegetectomy under vena caval inflow occlusion (VCIO). Five patients were intravenous drug users. None of them had left-sided heart valve involvement. The clinical indications for operating were recurrent septic pulmonary emboli with significant bilateral lung infiltrates and intractable infection with signs of severe systemic sepsis, despite treatment with appropriate intravenous antibiotics for a mean duration of 126 hours. The echocardiographic indication was very large localized >1 cm vegetations in all patients. Six patients had methicillin sensitive staphylococcus aureus and one had streptococcus viridans positive blood cultures. Five patients had postoperative high volume veno-venous hemofiltration (HVVF).

**Results:** There were no deaths. VCIO time did not exceed 2 minutes (range time was 45 seconds to 2 minutes). All patients had resolution of sepsis and improvement in respiratory status within 48 hours. Five patients had trivial and two moderate tricuspid regurgitation. Six patients were discharged home within 14 days with no long-term sequelae. One patient required long-term dialysis for renal failure. One patient required a late thoracotomy for drainage of a loculated empyema.

**Conclusions:** Tricuspid valve vegetectomy can be performed safely under VCIO. HVVF promotes removal of inflammatory mediators, thus improving recovery. (*Ann Thorac Cardiovasc Surg* 2002; 8: 350–3)

**Key words:** tricuspid valve, endocarditis, inflow occlusion

### Introduction

Tricuspid valve endocarditis (TVE) can be difficult to treat, primarily because of its association with significant respiratory involvement.<sup>1)</sup> Removal of the infected vegetation, along with tricuspid valve repair or replacement,

is the treatment of choice<sup>2,3)</sup> though some groups have advocated tricuspid valve resection as a radical measure.<sup>4)</sup> Unfortunately, all of these treatment options require cardiopulmonary bypass, which carries significant risks of worsening of the generalised inflammatory response and deterioration of lung function.<sup>5)</sup>

We chose to explore an off-pump technique whereby the infective focus on the tricuspid valve was excised under a brief period of vena caval inflow occlusion (VCIO). At the same sitting, attempts were made to drain and explore both pleural cavities. We present our experience.

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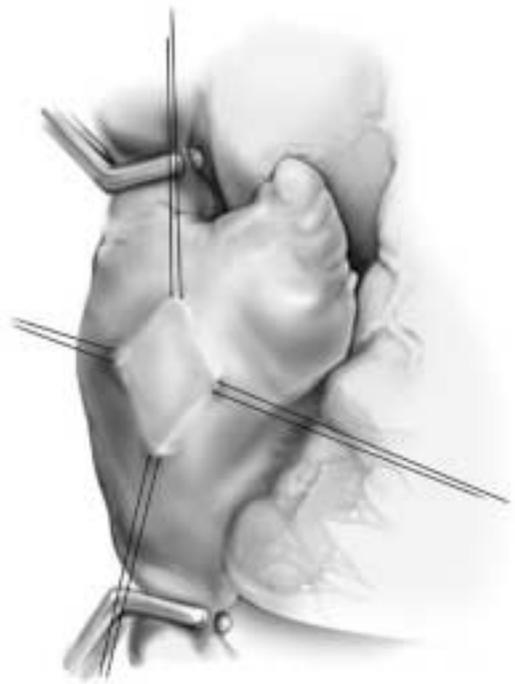
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### Patients and Methods

This report focuses on seven patients with isolated TVE



**Fig. 1.** Tricuspid valve vegetation.



**Fig. 2.** Stay sutures on body of right atrium.

who underwent vegetectomy between July 1998 and July 2001. The mean age of the patients was 26 years (range: 18 to 34 years). Five of the seven patients had recently used intravenous drugs of addiction. All patients were febrile with bilateral pulmonary involvement and signs of systemic sepsis. There was an element of renal impairment in all patients. Methicillin sensitive staphylococcus aureus was isolated from six patients while the other had a persistent streptococcus viridans infection. Surgical intervention was contemplated because of failure of intensive intravenous antibiotic therapy over a week in four patients and over 72 hours in the remainder. All patients had serial echocardiographic assessments of the heart to determine the size and location of vegetations. All patients showed very localized large persistent vegetations (>1 cm) on echocardiography. Valve function was also assessed at these examinations. Care was taken to look for patent foramen ovale and atrial septal defects.

The indications for surgery were:

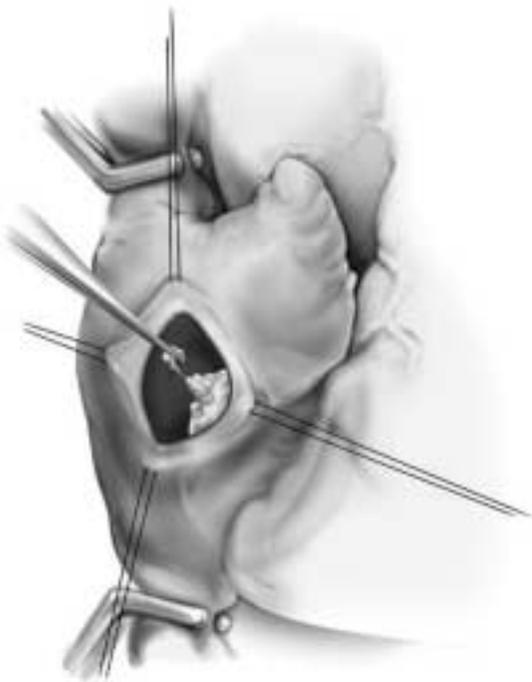
- Unrelenting systemic sepsis, not responsive to intravenous antibiotics
- Bilateral pulmonary infiltrates with deteriorating respiratory status

- Vegetations larger than 1 cm that increased in size despite maximal medical therapy

The mean duration of antibiotic therapy was 126 hours before intervention.

#### **Surgical technique**

The chest was opened through a median sternotomy incision and a pericardial cradle formed. The superior and inferior vena cavae (SVC and IVC) were dissected free and slings placed around them. The body of the right atrium was brought into view and four stay sutures placed (Fig. 1). Ten thousand units of heparin were administered systemically. The SVC and IVC were then clamped and the body of the right atrium opened vertically between the stay sutures (Fig. 2). The tricuspid valve was visualised and the vegetation excised (Fig. 3). The right atrium cavity was washed out with antibiotic solution. Next, a partial occluding clamp with a long flat jaw was then applied to the right atrium incorporating the edges and the stay sutures (Fig. 4). The caval clamps were then released. Care was taken never to cross the two-minute mark under VCIO. Second openings of the atrium were not required in this series. The edges of the atrial incision were



**Fig. 3.** Right atrium opened under vena caval inflow occlusion vegetation being removed.



**Fig. 4.** Closure of right atrium under partial occluding clamp.

approximated within the clamp with 4/0 prolene sutures. The pericardium was then closed. Both pleural cavities were opened and the lung surface inspected. Areas of loculation were broken down and abscess cavities drained. Any area of trapped lung was freed. Two large bore chest drains were placed in each pleural cavity. The sternum was closed with wires.

Postoperatively, five patients received high volume veno-venous hemofiltration (4-6 L exchanges per hour) for a mean of 36 hours. Vascular access was obtained with 13.5 FG dual lumen catheters (Niagara, Bard, Ontario, Canada). High volume hemofiltration was performed using a BM 11/14 machine (Baxter Healthcare, Sydney, Australia) along with a 1.6 square metre AN69 filter (Filtral 16, Hospal Pty Ltd., Lyon, France). Blood flow was set at 300 ml/min to enable the desired exchange while the ultrafiltrate flow was 100 ml/min. Lactate buffered replacement fluid (Baxter Healthcare) was used, one third being administered pre-filter to avoid excessive hemoconcentration. Other fluids, not related to hemofiltration, were controlled by the attending physicians. Additional potassium and phosphate ions were added to each 5 litre

bag of replacement fluid to prevent hypophosphatemia and hypokalemia. All replacement fluid was warmed. Heparin sodium was administered pre-filter at a rate of 1,000 IU/hour while protamine was administered post-filter at a rate of 10 mg/hour. This provided regional anticoagulation and avoided the bleeding risks associated with systemic heparinisation. Norepinephrine infusions were titrated to maintain a mean arterial pressure of at least 70 mmHg during the septic state.

## Results

There were no deaths. VCIO was no more than 2 minutes (range time was 45 sec to 2 minutes). All patients also underwent drainage of bilateral pleural effusions. Three patients had pulmonary decortication for empyema at the same sitting. Patients had resolution of the septic state within 48 hours, as evidenced by a fall in temperature, reduction in inflammatory markers and declining need for norepinephrine infusions. There was a dramatic improvement in respiratory status within the first 48 hours after surgery as evidenced by early weaning from the ventilator, improvement in oxygenation, and progressive reso-

lution of chest X-ray changes. One patient required a unilateral decortication six weeks after surgery, due to a delayed and persistent pleural reaction. Another patient had persistent abnormal chest X-ray changes, suggestive of a localized unilateral pleural reaction with no underlying lung involvement. Three patients suffered severe renal impairment preoperatively. One of these patients went on to receive long-term hemodialysis, whereas the other two patients had full recovery of renal function. Mean hospital stay was 14 days. All patients received long-term intravenous antibiotics for 6 weeks, postoperatively. Five patients had trivial to mild, while two had moderate tricuspid regurgitation on postoperative echocardiograms. At a mean follow-up of 19 months (range: 4 to 40 months), there have been no recurrent tricuspid valve infections. There had been no progression of regurgitation of the tricuspid valves at the last follow-up echocardiogram. All of the patients who had used intravenous drugs stopped their habit after intensive counselling and drug rehabilitation.

## Discussion

Tricuspid valve endocarditis is often treated medically with reasonably good results.<sup>6)</sup> However, persistent infection may suggest the presence of a large vegetation that may not be easily sterilised. Many groups have advocated ingenious and innovative ways of preserving the tricuspid valve while removing infected material.<sup>7,8)</sup> Surgical intervention in the setting of lung sepsis carries the risk of worsening the lung condition if the patient had to undergo cardiopulmonary bypass (CPB). In addition, CPB causes an inflammatory response with activation of complement and a host of cytokines that can amplify a raging septic state.<sup>5)</sup> For these reasons, we chose to use the off-pump route by employing a well-described technique of VCIO. High volume veno-venous hemofiltration has been shown to remove cytokines and complement in the setting of sepsis.<sup>9,10)</sup> There is evidence that it improves respiratory function, presumably by mobilising lung water.<sup>11,12)</sup> We started using it as an adjunct in treating patients with infective endocarditis in 1998 and adopted it for the patients listed in this report.

We chose not to compare this group with patients undergoing more radical tricuspid valve reconstructions or replacements on pump, because most of them were in the setting of multiple valve endocarditis.

While this is a small series, it does demonstrate the feasibility of off-pump tricuspid vegetectomy. This pro-

cedure removes the septic focus while preserving the valve and avoids the downside of CPB. Early institution of high volume hemofiltration helps to control the septic circulatory state, thereby facilitating early recovery. However, this technique would not be useful if there was significant destruction of the tricuspid valve, a significant patent foramen ovale or if there was significant involvement of left-sided heart valves.

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