

# BRIEF COMMUNICATIONS

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## ORTHOTOPIC CARDIAC TRANSPLANTATION AFTER MINIMALLY INVASIVE DIRECT CORONARY ARTERY BYPASS

Michael J. Reardon, MD, George V. Letsou, MD, James E. Anderson, MD, Hazim J. Safi, MD, Rafael Espada, MD, and John C. Baldwin, MD, *Houston, Tex*

Coronary artery bypass (CAB) without the use of cardiopulmonary bypass (CPB) has been performed since the earliest days of coronary surgery. Recently, interest in off-pump bypass has increased rapidly as a way to perform CAB at less cost and morbidity. Most current publications on minimally invasive direct coronary artery bypass (MIDCAB) deal with surgical technique, feasibility, and early results. The recent review of MIDCAB grafting by Calafiore and associates<sup>1</sup> provides an excellent summary of this subject, as well as addressing concerns with the procedure. The evolution of this procedure has also seen the emergence of complications associated with MIDCAB that may represent an under-reporting of problems.<sup>2,3</sup> We report the case of a patient requiring orthotopic cardiac transplantation after MIDCAB.

**Clinical summary.** A 68-year-old man was admitted on March 4, 1997, with shortness of breath and extreme fatigue with minimal exertion consistent with severe congestive heart failure. Five years before this admission he was evaluated for angina and found to have an isolated 90% stenosis of the left anterior descending (LAD) coronary artery and an ejection fraction of 45%. Successful percutaneous transluminal coronary angioplasty (PTCA) was accomplished with relief of angina. Two years later recurrent angina and LAD stenosis developed and he again responded to successful PTCA. Six months before admission, angina again developed. The patient was found to have a long stenosis of the LAD as an isolated lesion and an ejection fraction of 35%. MIDCAB with a left internal thoracic artery graft to the LAD was performed at another institution and he was discharged without angina. Three weeks after discharge, angina developed yet again, with the additional symptoms of shortness of breath with moderate exertion. Cardiac catheterization revealed a severe stenosis of the left internal thoracic artery graft at its anastomosis to the LAD, as well as an ejection fraction of

20%. Attempted PTCA of the anastomosis was unsuccessful. Further clinical deterioration prompted transfer to our facility with admission for intravenous inotropic support. Cardiac catheterization at that admission showed a cardiac index of 1.29 L/min per square meter, a pulmonary artery pressure of 65/37 mm Hg, a pulmonary capillary wedge pressure of 32 mm Hg, and a central venous pressure of 19 mm Hg. Deteriorating clinical status, as well as rising hepatic enzyme levels and decreasing renal function, prompted consideration for cardiac transplantation. On March 1, 1997, orthotopic cardiac transplantation from a 35-year-old male donor was successfully accomplished. The postoperative course was uneventful, and the patient is doing well at home without symptoms at this time.

**Discussion.** The surgical treatment of ischemic heart disease has a long and interesting history. The initial direct approaches to coronary artery obstruction were done without the use of CPB.<sup>1,2</sup> However, without CPB for hemodynamic support, the extent and accuracy of the coronary surgery often suffered. Subsequently, median sternotomy, CPB, and myocardial protection became the cornerstones of modern coronary artery surgery, allowing an excellent operating environment and access to all coronary arteries. Recently a rapid recurrence of interest in off-pump CAB as a form of minimally invasive CAB has arisen.<sup>1</sup> This world-wide phenomenon follows the explosion of laparoscopic techniques in general surgery in an attempt to extend minimally invasive technique into thoracic surgery. The majority of the recent literature on beating-heart CAB has been focused on surgical techniques, feasibility, and early results.<sup>4-7</sup> Growing experience with this technique led to its application in patients with decreased left ventricular function.<sup>8</sup> However, complications with the beating-heart anastomosis have been reported<sup>2</sup> and seen in cases performed by experts at MIDCAB conferences. In our clinical setting, we have seen referrals for PTCA and redo CAB after anastomotic failure in patients undergoing MIDCAB, and we have reported our concerns with the procedure.<sup>9</sup> The case reported here is the first one in which we have had to perform a cardiac transplantation after failed MIDCAB and, to our knowledge, the first reported cardiac transplantation after an unsuccessful MIDCAB procedure.

**Summary.** Recent experience at our institution and others supports the feasibility of the MIDCAB procedure in selected cases. Whether it can be mastered by the average cardiac surgeon and provide equal or better early graft patency, com-

From the Division of Cardiothoracic Surgery, Department of Surgery, Baylor College of Medicine, The Methodist Hospital, Houston, Tex.

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Address for reprints: Michael J. Reardon, MD, 6550 Fannin, Suite 1619, Houston, TX 77030.

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pleteness of revascularization, and long-term outcome remain to be proved. In the meantime, complications of this procedure should be studied to allow adequate assessment of the risk involved.

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## SHORT-TERM EFFECT OF CYCLOSPORINE ON CIRCULATING ADRENOMEDULLIN AFTER HEART TRANSPLANTATION

Bernard Geny, MD, PhD, Hélène Hardy, Eliane Lampert, MD, Anne Charloux, MD, Arnaud Charpentier, MD, Jean Lonsdorfer, MD, Pascal Haberey, MD, and François Piquard, PhD, *Strasbourg, France*

Adrenomedullin (ADM) is a newly discovered potent endogenous vasorelaxing and natriuretic peptide produced by vascular smooth muscle and endothelial cells.<sup>1</sup> Secreted by the failing human heart in proportion to the severity of the disease, ADM has been proposed to oppose the local and circulating vasoconstrictive and sodium-retaining factors during heart disease.<sup>2</sup>

Cardiac transplantation, an important surgical treatment for end-stage heart failure, partially normalizes the neurohumoral activation, but heart transplant recipients generally have hypertension and body fluid volume expansion. This may explain why both cardiac hormones, atrial and brain natriuretic peptides, remain elevated after heart transplantation.<sup>3</sup> Consistently, ADM has recently been reported to be elevated in heart transplant recipients in relation to cyclosporine (CsA) therapy (INN: ciclosporin), suggesting that ADM

might be a compensatory mechanism to offset further CsA-induced development of cardiac or renal dysfunction.<sup>4</sup> However, whether CsA acutely increases the third cardiac hormone, ADM, in heart transplant recipients remains unknown.

**Methods and results.** Six heart transplant recipients gave informed consent and participated in the study, which was approved by the institutional review board for human studies. Resting values of plasma ADM, CsA, and creatinine, together with systemic blood pressure, were determined with the patient in the supine position, and the time courses of both plasma ADM and CsA were obtained simultaneously during the 7 hours after oral CsA administration (125 mg twice a day). Plasma ADM concentration was determined by radioimmunoassay with kits from Peninsula Laboratories (Belmont, Calif), after extraction by Sep-Pak C18 cartridges (Waters Corporation, Milford, Mass.). Total blood cyclosporinemia was determined by immunoenzymatic assay using kits from Behring Diagnostics Inc (Cupertino, Calif).

Heart transplant recipients were  $47 \pm 4$  (mean  $\pm$  SEM) years old, weighed  $70 \pm 3$  kg, and the delay since transplantation was  $44 \pm 9$  months. Systolic and diastolic blood pressures were  $157 \pm 9$  and  $98 \pm 4$  mm Hg, respectively, and serum creatinine concentration was  $108 \pm 7$   $\mu$ mol/L. Circulating ADM was higher than control values ( $110 \pm 17$  vs  $20 \pm 3$  pmol/L in heart transplant recipients and control subjects, respectively; analysis of variance,  $P < .0001$ ) and tended to correlate positively with

From Laboratoire des Régulations Physiologiques et des Rythmes Biologiques chez l'Homme et Service de Chirurgie Cardio-Vasculaire, Faculté de Médecine, Strasbourg, France.

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Address for reprints: Bernard Geny, MD, PhD, Institut de Physiologie, Faculté de Médecine, 67085 Strasbourg Cedex, France.

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