Mid-Term Results After Thoracoscopic Transmyocardial Laser Revascularization

Gary S. Allen, MD

Department of Cardiothoracic Surgery, Cardiovascular Surgeons, PA, Orlando, Florida, and Osceola Regional Medical Center, Kissimmee, Florida

Background. **Transmyocardial revascularization is a surgical therapy for the relief of severe angina in patients who are not suitable candidates for coronary artery bypass graft surgery or percutaneous coronary interventions. Historically, surgical techniques employed a left thoracotomy with or without thoracoscopic assist for visualization. This study evaluated the feasibility and midterm outcomes after transmyocardial laser revascularization performed using a completely thoracoscopic, closed chest approach.**

Methods. **Patients (9 men [90%] and 1 woman [10%]) at a mean age of 66 ± 10 years who were ineligible for coronary artery bypass graft surgery or percutaneous coronary intervention underwent sole therapy transmyocardial laser revascularization using a completely thoracoscopic surgical approach using a holmium:yttrium-aluminum-garnet laser system. Preoperatively, patients had a mean ejection fraction of 0.51 ± 0.09 and a mean angina class of 3.7 ± 0.5.**

Results. **A mean of 30 ± 2.4 channels were created during mean laser and operative procedure times of 14 ± 2.9 and 133 ± 32 minutes, respectively. Patients were extubated at a mean of 7.6 ± 12 hours and were discharged from the hospital at a mean of 5.4 ± 3.4 days. There were no hospital deaths or major complications. At a mean of 8.4 ± 5.5 months postoperatively, all patients survived and significant clinical improvement with a mean angina class of 1.3 ± 0.5 ($p < 0.001$).**

Conclusions. **A completely thoracoscopic surgical approach is feasible for sole therapy transmyocardial revascularization that affords improved visualization over a limited thoracotomy approach. Limited complications and significant clinical improvement after the procedure were observed. With minimal port manipulation, there is an opportunity for decreased postoperative pain; however, larger studies are warranted to verify this hypothesis.**

(Ann Thorac Surg 2005;80:553–8)

Despite the availability of percutaneous coronary interventions (PCI) and coronary artery bypass graft (bypass) surgery, a growing number of patients develop a pattern of diffuse coronary artery disease that is both refractory to medical therapy and not amenable to these treatment modalities [1]. Transmyocardial revascularization (TMR) is a surgical option that, when applied as sole therapy in selected patients within this difficult patient population, is acknowledged by The Society of Thoracic Surgeons Workforce on Evidence-Based Surgery as useful and effective [2]. Among multiple prospective randomized trials with 1 year of follow-up, TMR has provided superior angina relief, improved exercise tolerance, decreased rehospitalizations, and improved event-free survival compared with continued medical management [3–7]. Continued 3- to 5-year follow-up has demonstrated sustained and significantly superior angina relief after TMR compared with medical therapy [8–10], with a survival benefit in one of these trials involving sicker class IV patients randomly assigned to TMR [8].

Sole therapy TMR has been conventionally applied using a standard or a limited left anterior thoracotomy, typically at the fifth intercostal space [11]. Whereas 1-year and long-term studies have identified the clinical and quality of life benefits after TMR, patients are nonetheless vulnerable to acute wound morbidities of the thoracotomy surgical approach. Consistent with the development of less invasive approaches in cardiothoracic surgery, initial thoracoscopic techniques have been reported for the TMR procedure [12–15]. These techniques support the general feasibility of such an approach. However, they largely represent a limited left anterior thoracotomy with thoracoscopically assisted visualization. To determine the feasibility and midterm benefits of completely thoracoscopic sole therapy TMR using video-assisted surgical techniques (VATS), we collected operative and follow-up data on 10 consecutive patients treated using this technique and report on their hospital course, adverse events, and Canadian Cardiovascular Society (CCS) angina class. Radiographic assessments of postoperative cardiac function and mechanism elucidation were beyond the scope of this initial feasibility study.

Accepted for publication Feb 14, 2005.

Address reprint requests to Dr Allen, 700 W Oak St, Kissimmee, FL 34741; e-mail: gary.allen@hcahealthcare.com.

Dr Allen discloses that he previously had but no longer has any financial relationship with Cardiogenesis.

Published by Elsevier Inc

0003-4975/05/$30.00
doi:10.1016/j.athoracsur.2005.02.060

Ann Thorac Surg
2005;80:553–8

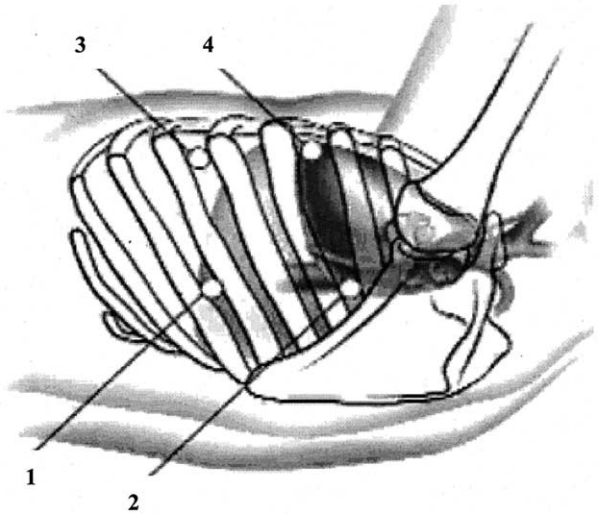

Fig 1. Port placement for completely thoracoscopic transmyocardial revascularization. Numbers 1–4 indicate the sites of the four thoracoscopic ports.

Patients and Methods

Patient Selection

Patients with medically refractory, severe angina who were not candidates for traditional methods of revascularization were identified as potential candidates for sole therapy TMR using a holmium:yttrium-aluminum-garnet (Ho:YAG) laser system and fiberoptic handpiece (Cardiogenesis Corporation, Foothill Ranch, California). In accordance with Institutional Review Board requirements, 10 consecutive patients referred between May 2003 and October 2004 consented to undergo the TMR procedure using a completely thoracoscopic approach and to the collection of data. There were no patients who underwent thoracotomy for sole therapy TMR during this period. Important enrollment criteria included (1) medically refractory, stable class III or IV angina that could not be treated with PCI or bypass surgery; (2) evidence of reversible ischemia as assessed using a combination of echocardiography, radionuclide ventriculography, and cardiac catheterization; (3) ejection fraction greater than 30%; (4) hemodynamically stable; (5) absence of ST-segment elevation myocardial infarction within the previous 3 weeks; and (6) absence of decompensated congestive heart failure.

Surgical Approach

Each patient was intubated with a double-lumen endotracheal tube and received general anesthesia using standard techniques. A transesophageal echocardiography probe was placed in each patient to confirm channel transmurality (by observing left ventricular microbubbles) and to assess left ventricular function. The patient was placed in the left thoracotomy position and "rescue" defibrillator pads were placed. In 3 patients with a history of ventricular irritability, a 100-mg bolus of lidocaine, followed a 2 mg/h maintenance drip was administered. The left lung was then deflated. Four thoracoscopic ports (Ethicon, New Brunswick, NJ) were inserted under direct visualization (Fig 1): (1) an 11-mm port at the sixth intercostal space at the level of the posterior axillary line of the left hemithorax; a 10-mm zero angle thoracoscope was inserted; (2) a 15-mm port at the third intercostal space at the anterior axillary line; this is the main operating site through which endoshear and lasing occurred; (3) an 11-mm port at the third intercostal space, 1 to 2 cm

Table 1. Baseline Patient Characteristics

Baseline Characteristic	Thoracoscopic Patient Group (n = 10)	Other Primary Thoracotomy Patient Groups		
		Allen (n = 132)	Milano (n = 22)[a]	Peterson (n = 661)
Time period	2003–2004	1995–1998	1995–1997	1998–2001
Age (years)	66 ± 10	60 ± 10	67 ± 6.9	62 ± 11
CCS class III/IV	30%/70%	0%/100%	55%/45%	32%/46%
Ejection fraction	0.51 ± 0.09	0.47 ± 0.11	0.46 ± 0.08	0.46 ± 0.13
Men	90%	74%	77%	70%
Atrial fibrillation	50%	nr	nr	nr
Congestive heart failure	20%	17%	nr	20%
COPD	20%	nr	nr	nr
Diabetes mellitus	50%	46%	42%	49%
Hyperlipidemia	100%	79%	55%	74%
Hypertension	100%	70%	68%	76%
Prior myocardial infarction	60%	64%	91%	53%
Prior bypass surgery	80%	86%	77%	87%
Prior bypass or PCI	80%	92%	nr	91%

[a] Semithoracoscopic approach in 2 patients; thoracotomy approach in 20 patients.

CCS = Canadian Cardiovascular Society; COPD = chronic obstructive pulmonary disease; nr = not reported; PCI = percutaneous coronary intervention.