Editorial

Cardiomyoplasty – Still a Promising Technique?

D.M. BRAILE
Rio Preto State Medical School and University of Campinas Medical School, Campinas, Brazil

Heart failure is one of the main causes of morbidity and mortality in the western world. It is a multifactorial disease with varied causes, and can be considered a prototype of a chronic disease which consequently leads to early death. While a number of new treatments have been developed, they only improve the symptoms or prolong life for a short period of time, but do not offer a cure [1]. The prevalence of heart failure has been steadily increasing all over the world. In the US alone, the incidence of this syndrome is currently close to 550,000 new cases annually, resulting in a death rate of 50% over five years. In the US in 2001, the cost of stroke due to congestive heart failure was estimated at $19 – 21 billion from a total cost of $298.2 billion for cardiovascular diseases and stroke [1,2]. In reality, patients suffering from Class III and IV end-stage heart failure, as determined by the New York Heart Association Classification, present with an extremely limited life expectancy, in spite of therapeutic advances produced by the latest treatment techniques.

The use of more appropriate drugs for its control, such as angiotensin-converting enzyme inhibitors, beta blockers, and nitric oxide, has not been sufficient to significantly reverse the mortality rate of these patients [3]. There are still questions relating to the effectiveness of ventricular resynchronization; despite improvement in the quality of life of patients, there is still no evidence of an increased survival rate [4]. Of the 100,000 patients in Germany and the 400,000 in the US suffering from severe drug-resistant end-stage heart failure each year, only 500 in Germany and 2500 in the US undergo heart transplantation. Another 370 patients in Germany and 700 in the US annually receive some type of "circulatory assistance" [4]. Attempts using the Batista operation for ventricular reduction have not resulted in the expected outcomes [5,6].

As a promising non-drug and non-resynchronization therapy, cardiomyoplasty was first described experimentally by Kantrowitz and McKinnon in 1959 [7] and applied to human beings in 1989 by Carpentier and Chachques [8]. Our group has employed the technique from 1988 until 1996 [9,10]. In this procedure, skeletal muscles are taken from a patient's back or abdomen and are wrapped around the failing heart. This added muscle, aided by ongoing stimulation from a cardiomyostimulator (a device similar to a pacemaker), may boost the heart's pumping motion. Given the severity and prevalence of heart failure and the promising results and innovations implemented by the cardiomyostimulator, the available stimulation modes, and its growing indication, we believe that cardiomyoplasty deserves reconsideration [9,11,12]. We found 68 references on cardiomyoplasty published over the last two years in four of the leading heart surgery journals (Journal of Thoracic and Cardiovascular Surgery, Annals of Thoracic Surgery, European Journal of Cardio-Thoracic Surgery, and Asian Cardiovascular & Thoracic Annals). Of these, 22 dealt with direct application of the technique.

When we began our experiments, the cardiomyostimulator only permitted adjustments in the number of stimuli in each burst and in the relationship between the burst and the heart beat in a predefined manner. These first stimulators (Model 4710 cardiomyostimulator, Medtronic, USA) were important for us in order to initiate our work. However, economic difficulties in Brazil prevented us from continuing to import this cardiomyostimulator. Instead, we continued to practice cardiomyoplasty using the Myos (Biotronik, Germany), which was greatly supported by Prof. Dr. Max Schaldach. This appliance included important innovations to improve the adaptation of the trained

skeletal muscle into its new function of optimizing the performance of the failing heart [13]. In 1994, we presented the results of 32 patients who underwent cardiomyoplasty using the Myos. This appliance enabled adaptation of the stimulation mode depending on the needs of the patient, allowing greater rest periods for the skeletal muscle, thereby increasing its performance and efficiency over time. Thus, a new concept of skeletal muscle stimulation was created, making the contractions more energetic after the rest period, thereby avoiding early degeneration. The results were promising primarily in patients suffering from dilated cardiomyopathies, with the exception of patients with Chagas' disease. The survival of these patients over five years was 94.0% ± 0.1% and over six years was 75.3% ± 0.22%, far higher than the life expectancy for heart failure patients at that time [13].

Recently, several investigations have rekindled interest in the area of cardiomyoplasty. Barron et al. [14] in 2001 demonstrated the possibility of improving the performance of the great dorsal skeletal muscle by modifying the mobilization technique, achieved by first separating the intercostal arteries and then performing its preconditioning "in situ." A comment about this article published by Alvarez [15] raises the question whether this type of surgery was abandoned too early, as happened with the pulmonary reduction technique in the 1950s. Kawaguchi et al. [16] demonstrated that cardiomyoplasty can reduce the oxygen consumption of the myocardium, thus improving the cardiac performance in patients with heart failure. A comment published by Santamore [17] emphasized the superiority of cardiomyoplasty over other techniques of diastolic restriction. In 2002 and 2003, Rigatelli et al. [11,18] showed the realistic possibility of employing cardiomyoplasty, evidencing its effectiveness for ventricular assistance, with maintenance of the skeletal muscle function when the conditions and manner of its stimulation were modified. According to Rigatelli in 2003, patient survival after a five-year period was 83.3%, reinforcing the idea that utilization of the technique with appropriate selection criteria produces satisfactory outcomes. Chekanov et al. [12] published a case report in 2002 that employed a new cardiomyostimulator with good results. In 2002, Chachques et al. [19] showed a favorable 72-month evaluation of patients submitted for cardiomyoplasty because of heart tumors, who had the ventricular wall reconstructed by chronically stimulated skeletal muscle.

In 2000, we published an investigation in which we studied 52 patients who had undergone cardiomyoplasty [9]. We reported the technique's results and suggested the possibility of concurrent implantation of defibrillators to avoid sudden death, one of the main causes of mortality during the postoperative period.

The question of whether cardiomyoplasty is still a promising technique was addressed in an article jointly published by Prof. Dr. Max Schaldach and myself in 1995 [20]. We suggested that the clinical benefit of cardiomyoplasty may be increased when used in combination with an autonomic nervous system-controlled cardiomyostimulator that stimulates the skeletal muscles according to the demands of cardiac output. This would permit rest periods, while increasing the efficiency of the muscular contraction, and maintaining the anatomic and functional integrity of the replaced muscle over an extended time. This method offers the opportunity to optimize the technique, which could still occupy an important position in the treatment of the insidious heart failure syndrome.

References

[1] Mark DB, Hlatky MA. Medical economics and the assessment of value in cardiovascular medicine. Circulation. 2002 (Part I); 106: 516-520.

[2] American Heart Association. 2001 Heart and Stroke Statistical Update. Dallas: American Heart Association, 2000. Avaliable at: URL: http://216.185.102.50/statistics/pdf/HSSTATS2001_1.0.pdf

[3] Minami K. Surgical treatment for end-stage heart failure due to dilated cardiomyopathy. Asian Cardiovasc Thorac Ann. 2001; 9: 159-166.

[4] Albert AE. Multisite biventricular pacing. Prog Biomed Res. 2002; 7: 213-215.

[5] Batista RJV, Verde J, Nery P, et al. Partial left ventriculectomy to treat end-stage heart disease. Ann Thorac Surg. 1997; 64: 634-638.

[6] Lucchese FA, Frota Filho JD, Blacher C, et al. Partial left ventriculectomy: overall and late results in 44 class IV patients with 4-year follow-up. J Card Surg. 2000; 15: 179-185.

[7] Kantrowitz A, McKinnon W. The experimental use of the diaphragm as an auxiliary myocardium. Surg Forum. 1959; 9: 266-268.

[8] Carpentier A, Chachques JC. Myocardial substitution with a stimulated skeletal muscle: first successful clinical case (letter). Lancet. 1985; 1: 1267.

[9] Braile DM, Godoy MF, Thèvenard GH, et al. Dynamic cardiomyoplasty: long-term clinical results in patients with dilated cardiomyopathy. Ann Thorac Surg. 2000; 69: 1445-1457.

[10] Braile DM. Cardiomioplastia dinâmica 10 anos: análise crítica do estado atual e experiência pessoal (Tese – Livre Docência). Rio de Janeiro. 1994. Available from: URL: http://www.braile.com.br/trabalhos/tese%20livre%20docencia.pdf

[11] Rigatelli G, Barbiero M, Rigatelli G, et al. Maintained benefits and improved survival of dynamic cardiomyoplasty by activity-rest stimulation: 5-year results of the Italian trial on 'demand' dynamic cardiomyoplasty. Eur J Cardiothorac Surg. 2003; 23: 81-85.

[12] Chekanov VS, Sands DE, Brown CS, et al. Cardiomyoplasty: First clinical case with new cardiomyostimulator. Asian Cardiovasc Thorac Ann. 2002; 10: 264-266.

[13] Braile DM, Soares MJF, Souza DRS, et al. Cardiomioplastia: novo gerador da Biotronik. Rev Bras Cir Cardiovasc. 1994; 9: 40-53.

[14] Barron DJ, Etherington PJ, Winlove CP, et al. Combination of preconditioning and delayed flap elevation: Evidence for improved perfusion and oxygenation of the latissimus dorsi muscle for cardiomyoplasty. Ann Thorac Surg. 2001; 71: 852-861.

[15] Alvarez JM. Dynamic cardiomyoplasty: "The truth that dare not speak its name" (Correspondence). Ann Thorac Surg. 2002; 73: 341-350.

[16] Kawaguchi O, Huang F, Yuasa T, et al. Cardiomyoplasty reduces myocardial oxygen consumption: implications for direct mechanical compression. Ann Thorac Surg. 2002; 74: 1092-1097.

[17] Santamore WP. Invited commentary. Ann Thorac Surg. 2002; 74: 1996-1997.

[18] Rigatelli G, Carraro U, Barbiero M, et al. Activity-rest stimulation protocol improves cardiac assistance in dynamic cardiomyopla0sty. Eur J Cardio-thorac Surg. 2002; 21: 478-482.

[19] Chachques J-C, Argyriadis PG, Latremouille C, et al. Cardiomyoplasty: ventricular reconstruction after tumor resection. J Thorac Cardiovasc Surg. 2002; 123: 889-894.

[20] Braile D, Brofmann PR, Shatalov K, et al. Clinical experience with ANS-controlled cardiomyoplasty (reprint from 1995). Prog Biomed Res (Collection of Reprints). 1998; 1: 281-284.

Contact
Prof. Domingo Marcolino Braile
Head of Cardiovascular Surgery
Rio Preto State Medical School and University of Campinas Medical School
Av. Juscelino Kubitscheck 1505 – Jardim Tarraf I
15091-450 – São José do Rio Preto
São Paulo State
Brazil
Phone: +55 17 2107000
Fax: +55 17 2107030
E-mail: domingo@braile.com.br