

CASE REPORT

Neuromuscular electrical stimulation in a patient with chronic heart failure due to chagas disease: a case report

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BACKGROUND

Chagas disease is endemic to South and Central America and frequently affects patients in their most productive working years. As a result, the disease is very costly for governments and societies.¹ Chronic cardiomyopathy is the most severe manifestation of human Chagas disease and can cause chronic heart failure (CHF), arrhythmia, heart block and sudden death.²

Exercise capacity has been shown to be related to poor survival in patients with Chagas disease. Previous studies have demonstrated that patients with Chagas infection present a poorer prognosis compared to patients with other causes of CHF.³ Despite these findings, data describing exercise training in CHF patients with Chagas disease are rare, especially regarding the use of the new and promising exercise training method known as neuromuscular electrostimulation (NMEE).

Case report

A 65-year-old sedentary male patient with 10 years of CHF symptoms due to Chagas disease was referred to the Department of Cardiac Rehabilitation of the Ana Neri Hospital - UFBA in August of 2009. The diagnosis of Chagas disease was defined by the positive result of two serological tests [indirect immunofluorescence and enzyme-linked immunosorbent assay (ELISA)]. To exclude the possibility of an ischemic heart disease, the patient underwent cardiac catheterization, followed by angiography. The studied patient was in New York Heart Association (NYHA) functional class IV and had a left ventricular ejection fraction of 40%. An evaluation of patient exercise capacity by a cardiopulmonary exercise test was initially attempted; however, the patient could not tolerate the testing because of excessive fatigue in the first minute of the exam. Instead, a six-minute walking test in a 30-m corridor was performed to evaluate the patient's exercise capacity. For this test,

previously standardized instructions were followed.⁴ In addition, the Minnesota Living With Heart Failure Questionnaire was administered (Table 1).⁵

After the initial assessment, the physiotherapy team chose the NMEE protocol for rehabilitation because of the patient's significant functional impairment and his inability to undergo conventional exercise training (Table 1).⁶ NMEE was performed on the right and left quadriceps for 60 minutes three times a week during for four weeks. NMEE was applied via an electrostimulator (Phisiotonus II, Bioset) on functional electrical stimulation (FES) mode. The carrier wave frequency was modulated at 50 Hz, with a pulse duration of 40 μ s. The stimulator was set to deliver 20 seconds of contraction and 4 seconds of relaxation. Adhesive surface electrodes 3 cm in diameter were used for electrostimulation. The current intensity was adjusted according to the sensitivity threshold of the patient.

The patient's current medication (carvedilol 12.5 mg/day, captopril 75 mg/day and furosemide 40 mg/day) was not changed during the protocol. This protocol was approved by the Ethical Committee of our institution, and the patient provided informed consent prior to participation.

DISCUSSION

The NMEE protocol was well tolerated by the patient, and no adverse events occurred.⁷ After the protocol, the patient performed another six-minute walking test and answered the Minnesota Living With Heart Failure Questionnaire. This reevaluation indicated a 380-meter increase in walked distance and a decrease of 15 points on the quality of life questionnaire score (Table 1).

In patients with Chagas disease, exercise training is an important aspect of cardiovascular rehabilitation; however, there are a minimum of controlled trials regarding this subject in the literature. The lack of trials may be related to the small prevalence of Chagas disease in developed countries or the high Chagas disease-associated incidence of malignant arrhythmia, sudden death and a consequent poor prognosis.^{2,3}

Despite a recent upsurge in the interest regarding the use of NMEE for treatment of CHF patients, there are only a modest number of small trials. Moreover, these trials do not

Table 1 – Patient data before and after NMEE treatment.

	<i>Before</i>	<i>After</i>
NYHA functional class	IV	III
Body Mass Index (kg/m ²)	19.1	19.4
Resting SBP (mmHg)	100	110
Resting DBP (mmHg)	80	80
Resting HR (bpm)	54	57
SBP during 6WT (mmHg)	110	130
DBP during 6WT (mmHg)	80	80
HR during 6WT (bpm)	75	68
Distance 6WT (meters)	120	500
MLHFQ Score	65	50
Borg Scale during 6WT	19	13
SpO ₂ during 6WT (%)	95	97

NYHA, New York Heart Association Functional Class; SBP, Systolic blood pressure; DBP, Diastolic blood pressure; HR, heart rate; MLHFQ, Minnesota Living with Heart Failure Questionnaire; 6WT, 6-minute walking test.

examine the etiology of Chagas disease. In CHF populations with left ventricular systolic dysfunction, NMEE appears to produce the same benefits as conventional physical exercise training by increasing both exercise capacity and quality of life.^{8,9} NMEE appears to be particularly useful in patients unable to perform conventional exercises, such as those in NYHA functional class IV.¹⁰

In the current report, the studied patient demonstrated severe functional impairment prior to treatment, which may have contributed to the large functional improvement observed in the relatively short intervention time. The functional capacity of patients in the initial phase of chronic Chagas heart disease is higher than those in advanced phases.¹¹

CONCLUSION

In the present report, NMEE was demonstrated to be a safe and efficient tool for improving exercise capacity

during cardiac rehabilitation in a CHF patient with Chagas disease. Further studies are necessary to better elucidate the risks, benefits and indications of NMEE.

REFERENCES

1. Wilson LS, Strosberg AM, Barrio K. Cost-effectiveness of Chagas disease interventions in Latin America and the Caribbean: Markov models. *Am J Trop Med Hyg.* 2005;73:901-10.
2. Rocha MO, Teixeira MM, Ribeiro AL. An update on the management of Chagas cardiomyopathy. *Expert Rev Anti Infect Ther.* 2007;5:727-743, doi: 10.1586/14787210.5.4.727.
3. Mady C, Cardoso RHA, Pereira-Barretto AC, da Luz PL, Bellotti G, Pileggi F. Survival and predictors of survival in patients with congestive heart failure due to Chagas' cardiomyopathy. *Circulation.* 1994;90:3098-102.
4. ATS Statement: Guidelines for the Six-Minute Walk Test. *Am J Respir Crit Care Med.* 2002;166:111-7.
5. Carvalho VO, Guimarães GV, Carrara D, Bacal F, Bocchi EA. Validation of the Portuguese Version of the Minnesota Living with Heart Failure Questionnaire. *Arq Bras Cardiol.* 2009;93:39-44, doi: 10.1590/S0066-782X2009000700008.
6. Carvalho VO, Mezzani A. Aerobic exercise training intensity in patients with chronic heart failure: principles of assessment and prescription. *Eur J Cardiovasc Prev Rehabil.* 2010;13. [Epub ahead of print] DOI: 10.1097/HJR.0b013e32833a9c63.
7. Carvalho VO, Roque JM, Bocchi EA, Ciolac EG, Guimaraes GV. Hemodynamic response in one session of strength exercise with and without electrostimulation in heart failure patients: A randomized controlled trial. *Cardiol J.* 2011;18:39-46.
8. Sbruzzi G, Ribeiro RA, Schaan BD, Signori LU, Silva AMV, Irigoyen MC, et al. Functional electrical stimulation in the treatment of patients with chronic heart failure: a meta-analysis of randomized controlled trials. *Eur J Cardiovasc Prev Rehabil.* 2010;17:254-60.
9. Karavidas A, Arapi SM, Pyrgakis V, Adamopoulos S. Functional electrical stimulation of lower limbs in patients with chronic heart failure. *Heart Fail Rev.* 2010 May 21. [Epub ahead of print] DOI 10.1007/s10741-010-9171-9.
10. Karavidas A, Parissis JT, Matzaraki V, Arapi S, Varounis C, Ikonomidis I, et al. Functional electrical stimulation is more effective in severe symptomatic heart failure patients and improves their adherence to rehabilitation programs. *J Card Fail.* 2010;16:244-9, doi: 10.1016/j.cardfail.2009.10.023.
11. Oliveira FP, Pedrosa RC, Giannella-Neto A. Gas exchange during exercise in different evolutionary stages of chronic Chagas' heart disease. *Arq Bras Cardiol.* 2000;75:481-98.