Contents available at Sciverse ScienceDirect

Diabetes Research and Clinical Practice

journal homepage: www.elsevier.com/locate/diabres

Brief report

Charcot foot: Skin temperature as a good clinical parameter for predicting disease outcome

Arnaldo Moura-Neto [a,*], *Tulio Diniz Fernandes* [b], *Denise Engelbrecht Zantut-Wittmann* [a], *Rafael Ortiz Trevisan* [b], *Marcos Hideyo Sakaki* [b], *Alexandre Leme Godoy Santos* [b], *Marcia Nery* [c], *Maria Candida Ribeiro Parisi* [a,c]

[a] *Endocrinology Division, Internal Medicine Department, Faculty of Medical Sciences, University of Campinas, Campinas, Sao Paulo, Brazil*
[b] *Orthopaedics Department, Medical School, University of Sao Paulo, Sao Paulo, Brazil*
[c] *Endocrinology Unit, Medical School, University of Sao Paulo, Sao Paulo, Brazil*

ARTICLE INFO

Article history:
Received 19 August 2011
Received in revised form
9 November 2011
Accepted 22 December 2011
Published on line 31 January 2012

Keywords:
Charcot's disease
Diabetic neuropathy
Consolidation time
Skin temperature
Clinical markers

SUMMARY

Twenty-eight diabetics presenting with acute Charcot foot were immobilized and the temperature difference between limbs measured at each month. All patients had monthly follow-up visits for a year and the relapse rate was zero. We found that skin temperature is a good parameter to ensure safe immobilization withdrawal.

1. Introduction

Treatment of acute Charcot foot involves immobilization and cessation of weight-bearing activities until bone consolidation [1,2]. The neuro-arthropathical process of Charcot foot was first described by Jean Marie Charcot [3], and nowadays is almost always associated with diabetes [4].

Some studies have, however, shown that weight bearing [5–7] and immobilization devices do not affect disease outcome. Morgan et al. [6] showed that using a CROW (Charcot Orthotic Restraint Walker) is useful in managing this condition without altering the disease's course.

In routine clinical care, the temperature (T) difference between both limbs is widely used to determine the beginning of the stable phase (T difference $< 2^{\circ}$ C). However, while some favor this as a deciding parameter [8,9], others disagree [10].

Our objective was to assess the effectiveness of inter-limb temperature difference as a clinical parameter of outcome in a group of patients with acute Charcot foot and the interference

* Corresponding author at: Faculdade de Ciencias Medicas, Departamento de Clinica Medica, Disciplina de Endocrinologia, Universidade Estadual de Campinas, Rua Tessalia Vieira de Camargo, 126 – Barao Geraldo, PO Box 13084-971, Campinas, Sao Paulo, Brazil. Tel.: +55 19 3251 7775.
E-mail address: arnaldo.mouraneto@gmail.com (A. Moura-Neto).
0168-8227/$ – see front matter
doi:10.1016/j.diabres.2011.12.029

of clinical presenting characteristics on time to bone consolidation.

2. Patients and methods

2.1. Study design

In this prospective, observational study, treatment protocol followed routine clinical practice and was identical in both institutions. Twenty-eight patients presenting with acute Charcot foot at the Foot Unit of the University of Sao Paulo and the Diabetic Foot Unit of the University of Campinas were enrolled from June 2007 to June 2009.

2.2. Data collection and follow-up protocol

Charcot anatomical presentation (according to Brodsky's classification [11]), Eichenholtz classification (1 or 2), age, sex, and diabetes type and duration were recorded at the initial evaluation. Patients had both limb temperatures measured, and the difference between limbs was recorded. Skin temperature was measured using an infrared skin thermometer (Minitemp, Raytec®), as previously described [12]. In summary, the infrared was pointed at the affected joint then again at the same spot on the non-affected limb, and temperatures compared. All subjects were immediately immobilized in a CROW, and instructed to bear weight normally but to restrain from heavy physical work.

All patients had monthly follow-up visits for a year and immobilization was withdrawn when the temperature difference dropped to less than 2 °C. Foot radiographic evaluation at each month was also obtained to ensure bone consolidation before immobilization withdrawal, as an extra safety measure [7,10]. All patients who progressed into the stable phase were followed for at least one year thereafter. Relapse was defined as a new elevation of T difference to greater than 2 °C.

The study was carried out in accordance with the declaration of Helsinki 1964 (18th World Medical Assembly) and was approved by each University's Ethics in Research Committee. Written informed consent was obtained from all subjects.

2.3. Statistical methods

Continuous variables are shown as mean (SD) and categorical variables are shown as frequency (percentage) unless otherwise stated.

Interference of baseline characteristics on time to resolution was studied using univariate and multivariate Cox proportional hazards regression analyses. Comparison of proportions of subgroups and resolution was assessed by Fisher's exact test.

Statistical significance was set at 0.05. Analyses were performed with the SAS System 9.1.3 Service Pack 3 (SAS Institute Inc., 2002–2003, Cary, NC, USA) and SPSS 13 (SPSS Inc., 1984–2004, Chicago, IL, USA).

3. Results

Patients' characteristics at the study beginning were as follows. Age 58.8 years (6.7); 14 males and 14 females; duration of diabetes: 14.3 years (5.1); initial T difference 4.7 °C (1.4); initial Eichenholtz 1: 11 patients (39.3%) and 2: 17 (70.7%); Brodsky classification: I 20 patients (71.4%), II 5 (17.9%), and IV 3 (10.7%). Three patients (10.7%) had bilateral disease (not simultaneous). Only the first limb affected was considered to avoid any possible interference on relapse. All subjects had type 2 diabetes.

3.1. Resolution of the acute phase and relapse rates

The one-year consolidation rate was 89.3%, with a mean time to consolidation of 6.6 months (2.1), range 3–12 months. We

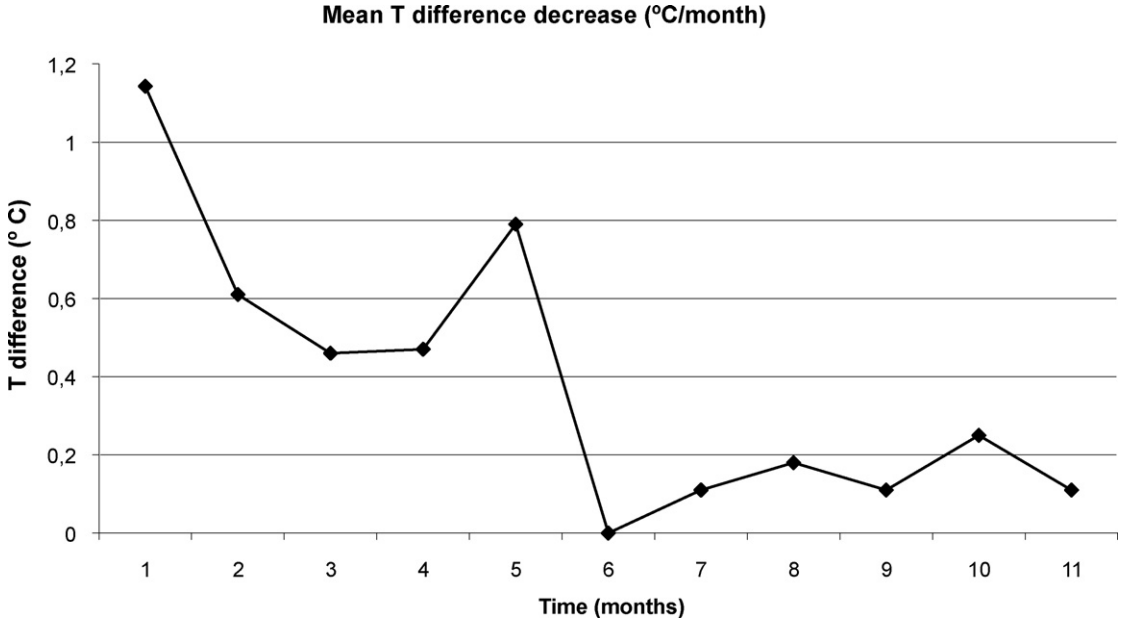

Fig. 1 – The graph shows the monthly mean T difference decrease velocity over the 12-month follow-up period.