Aspects of tropical ulcerating diseases
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Chapter 2

Microcirculatory changes in travellers to a tropical country


Abstract

**Background** Travellers to tropical areas seem to be affected by nonhealing leg ulcers more frequently. One of the factors that can affect wound healing in a negative manner is leg edema. This study was performed to determine whether there is increased leg edema in travelers to tropical areas.

**Method** In this study, we measured the capillary filtration rate (CFR) of the lower leg by strain gauge plethysmography, as a measure of leg edema, on location in Surinam. Three groups were included: A, travelers in the first few weeks after arrival; B, travelers who had stayed in the tropics for a minimum of 2 months; C, native inhabitants.

**Results** The mean CFR (mL/100 mL tissue/min) was significantly higher in group A than in groups B and C; the difference between groups B and C was not significant (group A 0.05 mL/100 mL tissue/min (standard deviation (SD), 0.03) vs. group B 0.02 mL/100 mL tissue/min (SD, 0.02), \( P = 0.01 \), and vs. group C 0.02 mL/100 mL tissue/min (SD, 0.02), \( P = 0.01 \)).

**Conclusions** Travellers to tropical areas are affected by increased CFR in the first few weeks after arrival. A prolonged stay leads to the normalization of the CFR. Compression therapy is recommended for travelers to the tropics.
Introduction

a well-known problem in the Department for Tropical and Imported Skin Diseases, Academic Medical Centre, Amsterdam, The Netherlands is the presence of serious (ulcerating) pyodermas, especially of the lower leg, in otherwise healthy patients returning home from a tropical country. To our knowledge, no studies have been performed on this subject, and the incidence of these pyodermas is unknown. In our clinical experience, these imported pyodermas seem to occur more often and last longer despite appropriate antimicrobial treatment than those acquired in a temperate climate. This may be the consequence of impaired wound healing. We hypothesized that, in travelers to tropical areas, a change from a temperate to hot climate may result in a subsequent change in the microcirculation of the dermal plexus. Adaptation to higher temperatures could lead to the distension of dermal capillaries, which may result in edema. It is well known that edema may delay wound healing.1 This is especially seen in venous insufficiency, where there is a marked increase in pressure in the veins of the lower leg, causing distension of dermal capillary beds and consequent widening of the endothelial pores.2,3 Blood elements leak out through the capillary wall into the surrounding tissue and form a specific microedema, which gives rise to a hypoxic block between the capillaries and the skin cells. Microedema can be eliminated by adequate compression therapy with elastic or nonelastic bandages.4
The purpose of this study was to determine whether increased leg edema could be found in travelers who had recently arrived in the tropics from a temperate climate. We measured the capillary filtration rate (CFR), as a measure of microedema, in travelers from The Netherlands who had just arrived in Surinam, South America, and compared the values with those of travelers from The Netherlands who had stayed in the tropics for a minimum of 2 months and with those of healthy native inhabitants.

Materials and methods

Patients

Three groups of healthy volunteers without a history or clinical signs of arterial or venous vascular diseases, and who were not taking any medication, were studied. None of the patients had consumed alcohol or had smoked during the day of the investigation. Group A consisted of Dutch students (12 Caucasians and one person of mixed Hindustani/Caucasian origin; five men and eight women; aged between 21 and 56 years; mean age, 37 years) who were investigated between 10 and 21 days after arrival by aeroplane in Surinam from The Netherlands. Group B, consisting of 13 Dutch Caucasian students (five women and eight men; aged between 21 and
37 years; mean age, 26 years), had stayed in Surinam for at least 2 months. Group C consisted of 14 local inhabitants of mixed black, Chinese, Indian, or Caucasian origin (nine women and five men; aged between 32 and 51 years; mean age, 42 years). No randomization was performed. Eight persons of group C were also investigated while visiting The Netherlands. They were all investigated 1 week after arrival in The Netherlands. Student’s t-test was performed.

Methods

Changes in tissue volume of the mid-calf caused by the CFR were calculated from changes in the diameter of the limb measured using a (mercury in rubber) strain gauge plethysmograph (Medasonics, model SPG-16).\(^5\)-\(^7\) Despite possible variations in results, due to the inaccuracy of the strain gauge depending on temperature or the exact position of fixation to the person investigated, this method was chosen as it is noninvasive, simple, portable, and repeatable without patient discomfort, and can be applied under field conditions in the tropics.

The person is rested for 15 min in the supine position; the leg is flexed slightly, the strain gauge is attached around the mid-calf at its widest diameter, and a pneumatic cuff is placed on the thigh. The cuff is then inflated to 60 mmHg, which provides venous occlusion without obstructing arterial inflow, thus preventing venous return and causing an increase in calf circumference and stretching of the strain gauge. The changed circumference of the strain gauge causes a difference in electric resistance, which is automatically interpreted and recorded by the apparatus. Obstructing the venous flow leads to an initial rapid volume increase in the lower leg (Fig. 1). After about 2 min, the maximum venous capacity is obtained, defined as the change in milliliters per 100 mL tissue. In the subsequent phase, a slight volume expansion occurs, caused by the filtration of fluid through the vessel wall into the surrounding tissue. The filtration rate is calculated as the filtration (mL/100 mL tissue) in time (min) measured between 6 and 15 min after venous obstruction (Fig. 1).

In this setting, we did not make use of a climate room as has been used in other studies, as the influence of the climate as a whole on CFR was our study object. As local temperature and humidity may interfere with capillary filtration, however, all measurements in Surinam were performed in the afternoon with a temperature around 32 °C and a humidity around 95%.
Chapter 2 Microcirculatory changes in travellers to a tropical country

Results

Group A, i.e. travellers who had recently arrived in Surinam, showed CFRs ranging from 0 to 0.1 mL/100 mL/min, with a mean value of 0.05 mL/100 mL/min (standard deviation (SD), 0.03) (Fig. 2). Group B, i.e. travelers who had stayed in Surinam for at least 2 months, showed CFRs ranging from 0 to 0.09 mL/100 mL/min, with a mean value of 0.02 mL/100 mL/min (SD, 0.02). Group C, i.e. local inhabitants, showed a mean CFR of 0.02 mL/100 mL/min (SD, 0.02; range, 0.01–0.07 mL/100 mL/min). Eight persons of this group were again investigated after a 1-week stay in The Netherlands. CFRs ranged from 0.01 to 0.05 mL/100 mL/min, with a mean value of 0.03 mL/100 mL/min (SD, 0.01). Although the values found in The Netherlands are higher compared to those found in Surinam in this group, they are not significantly different. Differences in CFRs between study groups A and B and between study groups A and C are significant ($P = 0.01$). The difference in CFR between group B and C is not significant.

Discussion

In our study, travellers who arrived by aeroplane from a temperate climate, such as that of Western Europe, to a tropical climate (with higher temperatures and higher humidity) had higher CFR values in the first few weeks after their arrival compared with travelers who had stayed in the tropics for at least 2 months and native...
inhabitants. It is known that at temperatures of 32 °C or higher the arteriovenous reflex is turned off. It is likely that, if a person is exposed to a rise in temperature, there will be a decompensation of the microcirculation, resulting in a higher CFR. After some weeks, adaptation takes place. This study suggests that persons who travel to the tropics are prone to the development of edema in the first few weeks after arrival. One would expect higher values in the first few days after arrival due to a long journey by aeroplane. Edema of the lower legs due to long distance flights has been confirmed. In this study, however, we focused on the period between 10 and 21 days after arrival, which makes the influence of the flight on CFR unlikely. Furthermore, travellers from Surinam to The Netherlands showed lower values than persons traveling the other way.

We have chosen the CFR method as it was the best available under local conditions. Despite large standard deviations, significant differences between study groups were detected. We did not include patients with actual nonhealing wounds in this study, as edema around these wounds might have interfered with the results.

To counteract the occurrence of leg edema, several kinds of compression stocking or bandage have been recommended. There is uncertainty about the most effective treatment, although it is generally accepted that high compression therapy, for example multilayer or short stretch bandages, is most effective in healing venous leg ulcers. Studies comparing different compression treatments have all been performed in temperate climates. No clinical data are available on the tolerability and

Figure 2. Capillary Filtration Rate in ml/100ml/min. group A, people investigated between 10 to 21 days after arrival in the tropics (N=13). group B, Dutch persons investigated after 2 months in the tropics (N=13). group C, local people (N=14).
efficacy of compression therapy in tropical conditions. Our personal experience is that bandages or stockings for high compression therapy, because of the high humidity and high temperatures, are often not well tolerated for periods longer than a few hours a day. Therefore, we are still cautious to recommend compression therapy for (ulcerating) pyodermas in the tropics; however, compression therapy could be an option for travellers with (ulcerating) pyodermas of the lower extremities after having returned from the tropics.

Reference List
