Background and Objectives

BACKGROUND: Worldwide, there are about 285 million people who have been diagnosed with Diabetes Mellitus (DM) and skin changes of various types occur in about 30-35% of persons with DM. Persons with type I are more likely to have autoimmune related skin lesions whereas persons with type II are more prone to cutaneous infections. In both types there appears to be a tendency for thinner skin and less than normal amounts of subcutaneous fat. The presence of such skin changes may indicate changes that alter skin water content that may precipitate further changes depending on the degree of glucose control, since excess glucose leads to non-enzymatic chemical reactions between the carbonyl group of glucose and amino acids. This glycation of structural and regulatory proteins plays a role in the pathogenesis of diabetic skin complications such as diabetic ulcer or diabetic foot syndrome. But, it is not clear how changes in tissue water content that may be associated with differing HbA1c values affect this process.

Purpose

The purpose of this study is to test the hypothesis that in persons with DM the dermal collagen glycation displaces bound water and thereby decreases skin tissue water. If true then a measurable relationship between skin water and HbA1c should be present. Hence, we are testing if there is a positive relationship between skin-to-fat tissue water as measured by TDC, and HbA1c values in persons with DM. Further because of already demonstrated differences in TDC values between genders these measurements are being conducted in both male and female subjects.

Protocol

TDC MEASUREMENTS were obtained using the MoistureMeter-D, Delfin Inc. (Figure 1). The MoistureMeter is a non-invasive, battery operated hand-held device utilizing gold plated brass open-ended coaxial probes (Figure 3a, b). Skin-to-fat tissue water was determined by measuring TDC at 300 MHz at anterior forearm, lateral calf and foot dorsum in DM patients who presented for a routine clinic visit. TDC measurements were made by touching the target skin site with a sensor for about 10 seconds. TDC values largely depend on the amount of free and bound water within the interrogation region. In this study four different sensors were used that allowed quantification to 0.5, 1.5, 2.5 and 5.0 mm below the epidermis. For reference, pure water has a TDC value of 76 at 34°C. All measurements are conducted on the dominant side of the subject. Each TDC measurement was done in triplicates and averaged.

Results

The initial hypothesis, that there is an inverse correlation between TDC values and HbA1c, is weakly supported by the present findings. At most, the correlation of foot TDC values with HbA1c would explain about 11% of the observed variation. We thus conclude that over the range of HbA1c values herein evaluated there is little effect of HbA1c on skin water as judged by TDC measurements. This finding suggests that persons with DM may be evaluated with TDC methods without fear of possible confounding effects related to variations in HbA1c. Further, the TDC values herein obtained provide a DM-related TDC reference data set.

References