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SKIN BLOOD FLOW IN DIABETIC PATIENTS DURING COLD LOADING

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INDEXING WORDS

periflux blood flow; microcirculation; diabetes mellitus; diabetic complication; autonomic neuropathy

SYNOPSIS

We measured periflux blood flow (PBF) in people's fingers and its response to cold loading with a laser Doppler flowmeter. As an index in the cold loading test we used cold recovery time (CRT).

Among normal people, CRT increased with age. Diabetics had significantly longer CRTs than did age-matched controls.

CRT seems to be useful for evaluating the skin microcirculation in diabetics and the aged.

INTRODUCTION

The periflux laser Doppler flowmeter (PLDF), first developed by Stern in 1975[12] and perfected by Nilsson et al.,[7] permits an easy, rapid, and non-invasive measurement of skin blood flow. We have used it to measure blood flow in various disease states.[3,8,9,10]

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The present study shows how the PBF response pattern during cold loading tests can tell us the peripheral microcirculation in people with diabetes mellitus.

MATERIALS AND METHODS

Sixty-six normal subjects (36 men and 30 women) aged 14 to 86 years (mean 49 years) and 51 diabetic patients with non-insulin-dependent diabetes mellitus (27 men and 24 women) aged 12 to 84 years (mean 51 years) were selected for the study.

A PLDF (Perimed, Sweden) applies the Doppler effect produced when a laser beam is reflected from moving erythrocytes.[3] The tip of the probe of a PLDF, using a 2 mW He-Ne laser, was placed in gentle contact with the finger-tips on the palmar side. Determination was performed at room temperature (20-25C), following rest in a sitting position for about 5 min with gain 3 at 12 KHz.

In the cold loading test, one hand was immersed in ice water for 10 seconds and the recovery time of PBF in the ipsilateral fingers was determined. The time was designated the cold recovery time (CRT). Figure 1 shows the standard pattern of PBF in normal subjects during a cold loading test.

Student's t test was used for statistical analysis.

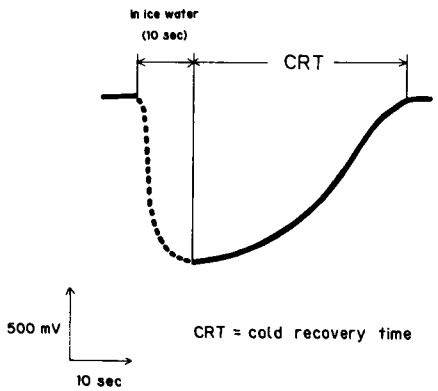

Fig. 1
Standard response pattern of PBF observed during the cold loading test in normal subjects.

RESULTS

The CRT was significantly longer in people with diabetes mellitus (69.7 ± 34.0 sec) (mean ±S.D.) than in normal subjects (47.6 ±18.7 sec) (Fig. 2). The CRTs in normal subjects aged 10 to

39 years (young group), aged 40 to 69 years (middle-aged group) and aged 70 to 89 years (elderly group), were 37.2 ± 17.8 sec, 45.9 ±12.1 sec and 59.6 ± 20.2 sec, respectively. CRT lengthened significantly with increasing age (Fig. 3).

Among diabetics, CRT was significantly longer in the young group (63.5 ± 39.2 sec) and in the middle-aged group (72.2 ±34.5 sec) than in the corresponding normal subjects (Fig. 4).

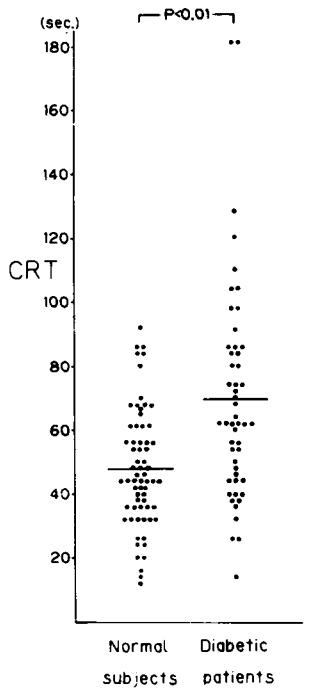

Fig. 2
CRT levels in normal subjects and diabetics.
Horizontal lines indicate the mean.

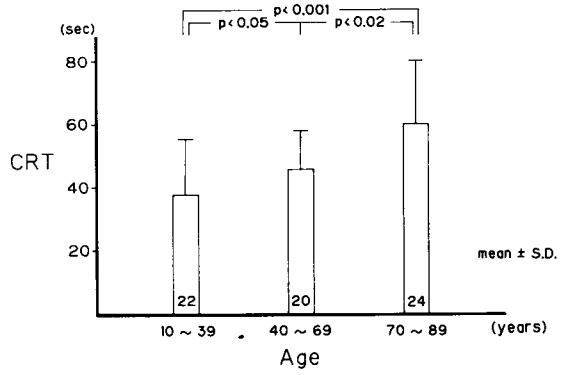

Fig. 3
CRT levels of the three age groups among normal subjects.
Figures in columns indicate the number of cases.
Vertical lines represent the mean ±S.D.

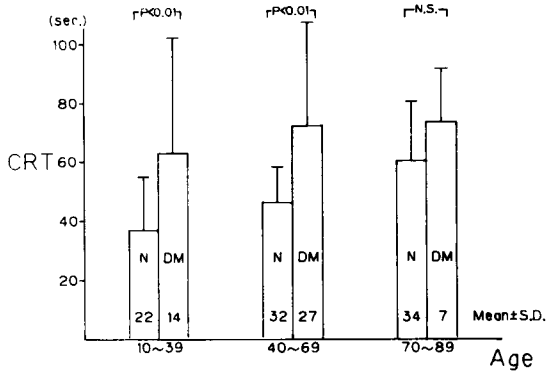

Fig. 4
CRT levels of the three age groups among normal subjects and diabetics.
Figures in columns indicate the number of cases.
N: normal subjects, DM: diabetic patients.
Vertical lines represent the mean ±S.D.

DISCUSSION

Recently, tissue hypoxia and peripheral microcirculatory disorders have received attention as causes of diabetic complications, and a lot of studies have been performed from the standpoint of hemorheology.[1,6,11] We have reported that PBF correlates with the severity of diabetic retinopathy, neuropathy and nephropathy, suggesting that diabetic complications could develop from disturbances in the peripheral circulatory system throughout the body.[8]

In clinical practice the Xe clearance method, fingertip volume pulse determination, digital blood pressure determination, thermography and the laser Doppler method have been used for the evaluation of microcirculatory disorder.[2,4] The PLDF is light, small and easy to manupulate. Furthermore, it enables one to determine the CRT within several minutes. Thus, the PLDF is considered to be clinically useful for evaluating skin blood flow. We have already reported that the analysis of PBF changes was useful for the clinical examination of the autonomic nervous system.[8,9,10]

In this study the analysis of CRT reveals itself to be a simple and useful method for examining peripheral vascular reactivity. CRT may represent the speed of the expansion of the arterial wall. Therefore, although much remains to be learned about the mechanism of the response to cold loading tests, we suggest that not only neurologic factors such as autonomic disorders or functional abnormality of the vascular smooth muscle but also peripheral arterial elastisity may play some role in the mechanism of arterial vasospasmus.[5] Thus, CRT was prolonged with increasing age. Furthermore, the prolongation of CRT in diabetic patients suggests that arterial elastisity or arteriosclerosis may be accelerated in subjects with diabetes mellitus when compared to age-matched control subjects.

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