Blood pressure and heart rate changes during leaning forward in normal and in NIDDM subjects

Dear Sir,

Leading forward results in a moderate increase of blood pressure in healthy individuals and is recommended as a physical manoeuver to alleviate dizziness in patients suffering from orthostatic hypotension [1]. In addition, patients with severe coronary artery disease may complain of angina during leaning forward (pronus angina) [2]. Although blood pressure and heart rate changes have been studied in detail during the lying-to-standing and squatting manoeuver [3, 4], we know of no report regarding the effect of leaning forward in diabetic persons. This study was undertaken to investigate the changes in blood pressure and heart rate during leaning forward in a sample of diabetic non-insulin-dependent (NIDDM) persons as well as in healthy individuals and to study whether the coexistence of objective signs of autonomic neuropathy is associated with these changes.

We studied 52 NIDDM patients (WHO criteria [5]), and 22 control subjects matched for age and sex. None of the study subjects had hypertension, clinically apparent peripheral arteriopathy, clinical and/or electrocardiographic signs of coronary artery disease, any condition known to affect the autonomic function, anaemia, acute illness or hypoglycaemia in the previous 48 h. Insulin or antidiabetic medication were witheld until the end of the examination.

All subjects underwent the battery of the five classical Ewing tests for autonomic neuropathy [3]. Autonomic neuropathy was diagnosed when two of the five tests were abnormal [6].

The subjects were divided in three groups, according to the presence of neuropathy: group 1, Control, $n = 22$; group 2, Diabetic without autonomic neuropathy, $n = 18$, and group 3, diabetic with autonomic neuropathy, $n = 34$. The mean age was 51.3 ± 9.2, 50.8 ± 13.0 and 53.0 ± 6.7 years for the three groups, respectively. The groups were not significantly different in terms of age, sex, systolic and diastolic blood pressure, height, BMI and smoking habits. Also, there were not any significant differences between groups 2 and 3 in duration of diabetes and in glycaemic control.

About 15 min after the end of the cardiovascular tests, subjects were asked to stand for 2 min from the sitting position and then to lean forward so that their hands reached their toes. To avoid tension of arm muscles, the arms were left hovering. Blood pressure and heart rate were measured twice at min 2 in the standing position and at min 1 while leaning forward with the Dinamap vital signs monitor (Johnson and Johnson, Arlington, Tex., USA).

Leaning forward resulted in significantly increased blood pressure in all subjects as compared to the standing position ($p < 0.0001$) (Table 1). The systolic blood pressure increase was significantly higher in diabetic persons with autonomic neuropathy as compared to diabetic persons without neuropathy and control subjects ($p = 0.032$). The same was valid for diastolic blood pressure ($p = 0.020$) (Table 1).

In contrast to blood pressure, heart rate showed only minimal and variable change during the leaning forward position. The median values (beats/min) were: 0.00 for group 1, --1.90 for group 2 and 0.95 for group 3 ($p > 0.05$).

It is known that leaning forward in healthy individuals results in a significant increase of both preload and afterload. Increased venous return, caused by the contracted muscles of the legs, together with a significant increase of intra-abdominal pressure result in an increase of the preload. The increase in afterload is attributed mainly to compression of the aorta due to increased intra-abdominal pressure and to kinking of the femoral arteries [1,2].

A significant association between autonomic neuropathy and median arterial calcinosis has already been described in diabetic persons [7]. In addition, aortic distensibility is reduced in sympathectomized rats [8]. Thus, it is possible that the greater increase in the blood pressure observed in diabetic persons with autonomic neuropathy is due to a reduction of the distensibility of the aortic wall. The clinical significance of this observation merits further investigation.

Yours sincerely,

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Table 1. Values (mean ± SD) of blood pressure in standing up as well as leaning forward position (LFP) in normal subjects (group 1) in NIDDM subjects without and with autonomic neuropathy (group 2 and group 3, respectively)

	Systolic blood pressure (mm Hg)			Diastolic blood pressure (mm Hg)		
	Standing	LFP	Change[a]	Standing	LFP	Change[a]
Group 1 ($n = 22$)	129.4 ± 22.8	137.3 ± 13.5	8.5 ± 18.7	80.2 ± 13.1	91.7 ± 12.3	12.4 ± 11.1
Group 2 ($n = 18$)	128.6 ± 14.5	141.4 ± 18.1	16.8 ± 15.7	83.1 ± 13.8	98.7 ± 14.7	15.5 ± 11.0
Group 3 ($n = 34$)	118.8 ± 17.5	141.2 ± 15.6	22.4 ± 13.4[b]	83.1 ± 13.6	99.3 ± 10.4	17.2 ± 12.2[c]

[a] $p < 0.0001$ vs the respective values in the standing position, [b] $p = 0.032$ and [c] $p = 0.020$ vs groups 1 and 2

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