BLOOD PRESSURE ELEVATION BY ICE IN THIRTY-EIGHT THAI VOLUNTEERS

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Following immersion of subjects 'index fingers in ice, systolic and diastolic blood pressure were elevated in all normotensive subjects between 21.5 and 39.2 year of age ($p<0.05$). After thirty-minute pretreatment of the 21.5 year group and 39.2 year group of subjects with oral paracetamol (500 mg) with diazepam (2 mg) or paracetamol with diazepam (4 mg) respectively, blood pressure measurements was made before and after ice immersion of the index fingers. During the ice immersion, the systolic and diastolic blood pressure, after the drugs pretreatment, were significantly increased from the premeasurement levels in all subjects under study ($p<0.05$). The results suggest that ice induces increase in blood pressure of normotensives, which is unaffected by pretreatment of the subjects with paracetamol with diazepam.

KEY WORDS : blood pressure, ice, Thai volunteers

INTRODUCTION

Blood pressure is the force that moves the blood through the circulatory system to nourish the body tissues. The sudden increase in the force which led to rupture of the blood vessels has been well documented. Massive brain hemorrhages have been a common cause of death in hypertensive patients with indequately

treated or uncontrolled hypertension.[1] Cerebrovascular accident is the major cause of all deaths in the elderly with abnormal consistent high blood pressure in affluent societies of the world.[2] In the American population, 40% of white and 50% of blacks over 65 years old are hypertensive.[3] Cold, by ice, as it cools the skin causes cutaneous vasoconstriction, significantly, reducing the amount of blood circulating in the extremities.[4] Increased peripheral resistance is the major factors that attributes to an increase in arterial blood pressure. Moreover, in most patients with hypertension, the peripheral vascular resistance increases.[5] Therefore, the effect of ice on the blood pressure change was investigated in normotensive volunteers.

MATERIALS AND METHODS

Subjects

Twenty eight dental students (21.5 ± 0.15 years) and eleven staff members of the Department of Pharmacology (39.2 ± 3.1 years) of both sexes took part in the study. None of the subjects took any other drugs during investigation. Informed consent was obtained from all subjects.

Study design

The experimental procedure was designed as a single-blind randomized study. Subjects were grouped according to age : group I subjects (21.5 ± 0.15 years) group II subjects (39.2 ± 3.1 years). All subjects were fasted 18 hours before the commencement of experiment and were studied at rest in a sitting position while the blood pressure was taken through the arm cuff and was recorded by an E&M Projector physiograph® recorder (a Narco Company, Houston, Texas). The ambient temperature was in between 26-27 °C. The recorder, having a plug-in cuff pump connected to the preamplifier, was calibrated to the fifty millimeters of mercury per two centimeters of writing pen deflection. The Korotkov sound was the recorded ; the first and the second sound were then calculated to be a systolic and a diastolic blood pressure respectively. All

groups of the subjects were then tested with ice by immersion of the index finger (2/3 part of finger tip) into the crushed ice in a small pyrex glass beaker (100 ml) until unbearable pain was experience. The blood pressure was measured in the same way as before.

After the blood pressure measurement, the group I subjects and the group II subjects were taken an unknown drug A* and drug B** respectively. Thirty minutes after the drugs, the blood pressures of the subjects were measured using the same equipment and method as previously mentioned.

Statistical analysis

Comparisons between data within a group were made using analysis of variance and Student's paired t-test whereas the data between the groups were also using analysis of variance and Student's unpaired t-test. The level of significeance was choosen as $p<0.05$.

RESULTS

The sitting arterial blood pressure obtained from other publication[6] showed that systolic and diastolic of the caucasians (24.1 years old) were 109.40 (S.D. 10.20), and 70.30 (S.D. 9.50) (n=24) respectively (table 1) ; the present study was shown to be 106.6 (S.D. 9.7) and 73.6 (S.D. 7.1) (age 21.5, n=27) (table 2). The ice caused the elevation of systolic blood pressure from 106.6 (S.E.M. 1.9) to 115.8 (S.E.M. 1.9) and diastolic from 73.6 (S.E.M. 1.4) to 78.5 (S.E.M. 2.9) (n=27) in the age 21.5 group (table 2) whereas the age 39.2 group, were elevated from 112.5 (S.E.M. 3.5) to 126.7 (S.E.M. 2.4) (n=11) (table 2). After pretreatment of the younger group with paracetamol and diazepam (2 mg) and the older group with the same drug as the younger did except diazepam (4 mg) was used instead, the systolic and diastolic blood pressure still elevated by ice ($p<0.05$). The drugs pretreatment did not

* Drug A was paracetamol (500 mg) and diazepam (2 mg)

** Drug B was paracetamol (500 mg) and diazepam (4 mg)

affect the systolic and diastolic blood pressure of both groups of subjects. However, the ice did elevated the blood pressure of the younger and older pretreated groups, the systolic from 104.8 (S.E.M. 3.9) to 115.3 (S.E.M. 2.1) and diastolic from 70.6 (S.E.M. 1.8) to 79.5 (S.E.M. 1.3) (n=27) were belonged to the younger age group, while the older age group, the systolic from 107.3 (S.E.M. 4.1) to 126.0 (S.E.M. 4.9) and diastolic from 60.3 (S.E.M. 3.8) to 74.0 (S.E.M. 3.6) (n=11) (table 3).

Table 1 The data of the systolic arterial blood pressure (systolic, diastolic) of the caucasians, measured by an electronic sphygmomanometer in a sitting position (a mean age was 24.1 years)[6] in the U.S.

	Arterial blood pressure (mm Hg) (mean ± standard deviation)	**N**
Systolic	109.40 ± 10.20	24
Diastolic	70.30 ± 9.50	24

N = number of subjects

Table 2 The effects of ice on the systolic, diastolic and mean arterial blood pressure of group I volunteers (age 21.5 ± 0.15 years) and group II (age 39.2 ± 3.1 years).

		Blood pressure (mm Hg) (Mean ± Standard Error of the mean)			
		Systolic	**Diastolic**	**Mean Blood Pressure**	**N**
Before	**Group I**	106.6 ± 1.9 (9.7)	73.6 ± 1.4 (7.1)	84.6 ± 1.3 (6.6)	27
	Group II	112.5 ± 3.5	61.8 ± 3.0	78.7 ± 2.9	11
After ice	**Group I**	115.8 ± 1.9 (9.7)	78.5 ± 2.9 (14.8)	92.5 ± 1.4 (7.1)	27
	Group II	126.7 ± 2.4 (7.9)	73.1 ± 2.5 (8.3)	90.9 ± 2.1 (6.9)	11

The typical physiographic records were showed in Fig. 1 and Fig. 2.

(N.B. The units of systolic and diastolic blood pressure are mmHg)

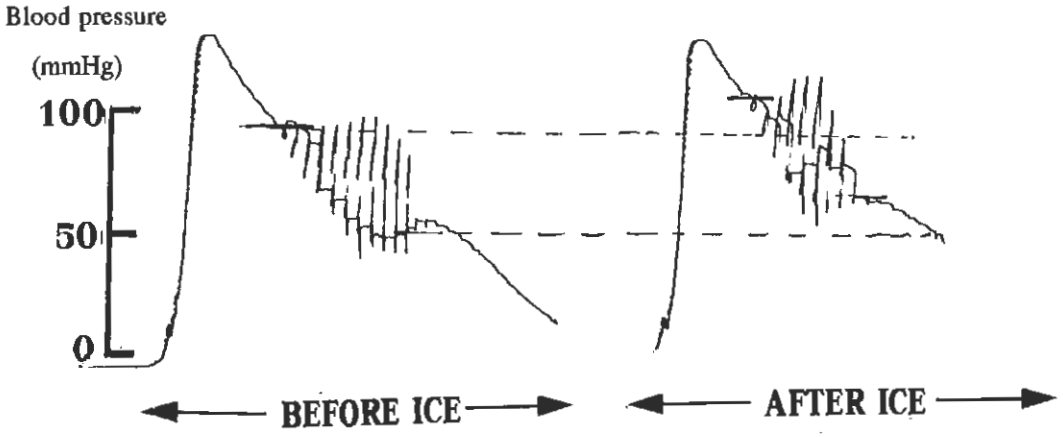

Fig. 1 A typical physiographic tracing of one subject showing Korotkov's sound recorded before and after experimentation with ice.

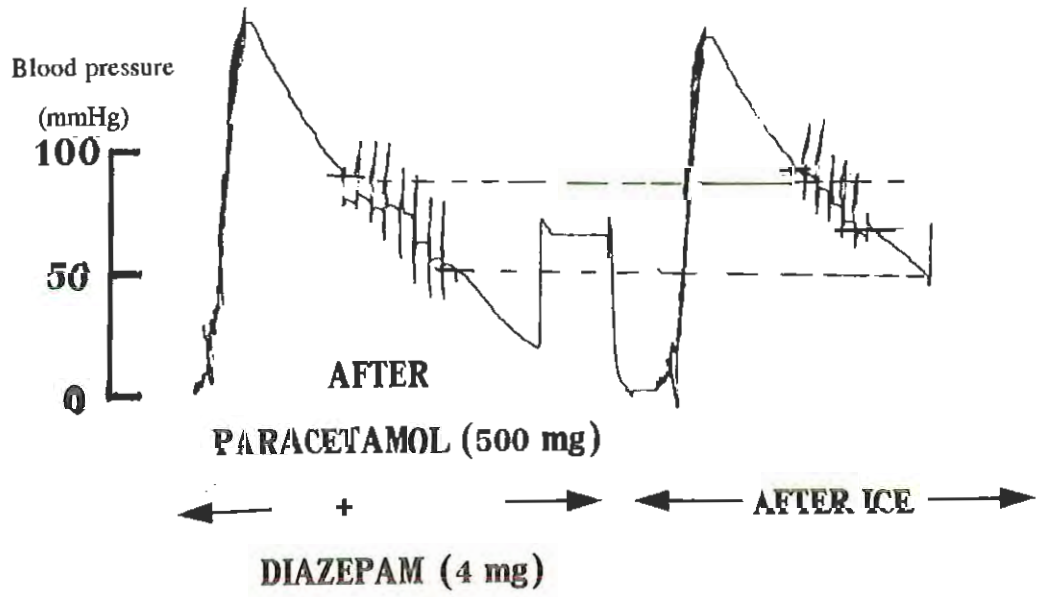

Fig. 2 A typing physiographic tracing showing a pretreatment of a subject with paracetamol (500 mg) plus diazepam (4 mg) before andafter experimentation with ice.

Table 3 The effects of paracetamol 1000 mg plus 2 mg of diazepam (Drug A) and paracetamol 500 mg plus 4 mg of diazepam (Drug B) on the systolic, diastolic and mean arterial blood pressure.

		Arterial blood pressure (mm Hg) (Mean ± Standard error of the mean)			
		Systolic	**Diastolic**	**Mean Blood Pressure**	**N**
Group I	**Drug A alone**	104.8 ± 3.9 (19.9)	70.6 ± 1.8 (9.2)	83.2 ± 1.8 (9.2)	27
	Drug A + Ice	115.3 ± 2.1 (10.7)	79.5 + 1.3 (6.6)	91.3 ± 1.3 (6.6)	
Group II	**Drug B alone**	107.3 ± 4.1 (11.5)	60.3 ± 3.8 (10.6)	75.9 ± 3.6 (10.1)	8
	Drug B + Ice	126.0 ± 4.9 (12.1)	74.0 ± 3.6 (10.1)	91.3 ± 3.9 (10.9)	

Note : The standard deviations are in the brackets.

DISCUSSION

Reaching adult life, the factor of age may make a remarkable difference of arterial blood pressure. Subsequent changes with age vary in different communities and from subject to subject. In some community, pressure does not rise with age,[7] which is in accord with the present finding in the two-age group. Between group I subjects (age 21.5 ± 0.15 years) and group II (age 39.2 ± 3.1 years), the pre-drug arterial systolic blood pressure are not statistically different ($p>0.05$). This may be due to a decrease in the volume distensibility of the increased age group (group II). Nearly the last two decades, both the systolic and diastolic blood pressure of the caucacian resided in the United States (age average 24.1 years), were about the same figures as the present study (table 1). The mechanisms by which ice induced hypertension have not yet been elucidated; a reflex pressor response of the cutaneous blood vessels might play a major role. Interestingly, the mean arterial blood pressure could be increased by severe ischemia of the brain to as high as 260 mmHg.[8] Thus, the existing brain ischemic hypertension could be worsened and brain

hemorrhage will be a consequent especially in the elderly. The subjects pretreated with paracetamol together with diazepam with a view to help prevent the subject from pain and anxiety that might more or less an increase in arterial blood pressure. However, the results of the given amount of both analgesic and a tranquillizer, had no effect on both the initial blood pressure and the ice-induced increase in blood pressure. Therefore, the ice-induced elevation of blood pressure should not go through the pain and anxiety pathway. The implication of the whole findings is that ice-induced elevation of blood pressure may aggravate the hypertensive state of an elderly.

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