POSTPRANDIAL VARIATIONS IN BLOOD PRESSURE IN THE ELDERLY PEOPLE

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ABSTRACT

Ageing is associated with changes and deterioration in functions and structure of many systems including cardiovascular system. Besides other changes the activity of baroreceptors and autonomic system, both of which are important for the homeostasis of blood pressure under different physiological conditions in daily life, is said to be reduced with the advancing age. Food intake is one of the important factors, which influence the cardiovascular system, and readjustments take place in the system for blood pressure homeostasis after ingestion of meal. The present study was planned to evaluate and compare the postprandial changes in blood pressure in young adults and elderly people. A total of 70 male healthy individuals (50 elderly & 20 young adults) were selected for the study. Blood pressure and pulse rate were measured before a standard breakfast and then at intervals of 15 minutes each, after meal, for one hour. In the young adults group, the systolic, diastolic and mean arterial pressure showed no significant change after meal while pulse pressure was raised for first 30 minutes after meal, returning again to almost pre-prandial level in next 30 minutes. The pulse rate was however increased significantly after meal. In the elderly subjects, on the other hand, there was moderate to marked decline in systolic, diastolic, mean arterial and pulse pressures without any increase in the pulse rate. This response to meal in the elderly subjects was found to be significantly different from that in the young adults.

INTRODUCTION

Syncope is a prevalent and potentially dangerous phenomenon in elderly people. In 47% of patients with syncope admitted in intensive care units of different hospitals, no apparent cause could be found despite extensive medical examinations and investigations'. Although this common event is often difficult to explain, there may be some common comprehensible factors that threaten blood pressure homeostasis in the elderly but are not routinely assessed in the course of medical evaluation. Ageing is characterized by universal progressive decline in physiological functions to the point where life cannot be maintained, in the face of otherwise trivial tissue injury[2] It was proposed by Kohn (1982) that senescence may be viewed as a disease and be accepted as a cause of death. Every process involved in the homeostasis becomes progressively less effective after growth cessation'. Aging is a complex process involving subtle changes in function of many systems, but in man the most frequent failure is of cardiovascular system. In elderly people the peripheral resistance is higher, the A-V oxygen difference is greater and the cardiac output is lower, in recumbent position, as compared to young adults. The systolic pressure increases with exercise and shows greater changes in older subjects[4].

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In elderly the relative thickness of the vessel walls increases progressively in more peripheral vessels, whereas in young there is a fairly constant wall thickness ratio and young arteries show a significantly greater retraction than old ones and in both groups the retraction increases progressively toward the periphery[5]. The baroreceptor sensitivity decreases with the increasing age[6]. There is inverse relationship between age and baroreceptor reflex sensitivity. This reduced baroreceptor sensitivity in elderly may be due to reduced dispensability of the vessel wall in baroreceptor area or it may be due baroreceptor degeneration[8,9].

Ingestion of meal in normal subjects has very modest effect on blood pressure while in the persons who have some degree of autonomic dysfunction there may be a marked reduction in blood pressure after ingestion of meal[10] The fall in blood pressure after ingestion of meal may be due to increased splanchnic blood flow resulting in relatively decreased availability' of blood to the other tissues. Brandt et al." had demonstrated the effect of oral proteins and glucose on splanchnic blood flow. It was observed that there was significant increase in splanchnic blood flow and splanchnic oxygen consumption after protein feeding. Bloom et al. [12] reported an increase in heart rate, arterial pressure and a transient increase in adrenal output of glucocorticoids during feeding in calf, the adrenal catecholamine's remained unaffected in these animals during feeding. They also reported an increase in mean arterial pressure and heart rate in young kids (age 1-3 weeks) with consumption of milk from an infant feeding bottle. The changes in heart rate were shown to be closely parallel to the mean arterial pressure. These changes were attributed to increased sympathetic activity-stimulated by feeding. A fall in blood pressure has also been reported after oral glucose ingestion, in autonomic dysfunction[11]. Significant fall in blood pressure may occur with changes in posture after carbohydrate meals in elderly subjects in whom baroreflex responses are less effective in counteracting sudden fall in cardiac output and this might explain the occasional occurrence of a cerebrovascular accident after a large meal[14]. Thus in elderly people in whom the autonomic nervous system and the baroreceptor activity are said to be blunted, there may be marked variations in postprandial blood pressure as compared to young adults.

MATERIALS AND METHODS

A total of 70 normal male subjects were examined during the course of study. The test subjects were belonging to the following groups:

1) Young adults, between the age of 20-30 years.
2) Elderly people, having age of 60 years and above.

All the subjects were randomly selected from the general population of Karachi. The subjects were briefed about the purpose and methods of the study before the start of the tests and their formal consent was taken. All the subjects were selected after careful and thorough clinical examination to exclude any systemic disease. People suffering from hypertension and other cardiovascular diseases, diabetes mellitus and other endocrine disorders, renal disease and other major illness were not included in the study. The selected subjects were on no medication. The group (1) comprised of 20 adult males and group (2) comprised of 50 elderly male subjects. One day before the examination, the subjects were advised not to take anything by mouth after 12 m.n. and to report for the examination with empty stomach at 7 am on the next morning. All the examinations were carried out in Department of Physiology, B.M.S.I., J.P.M.C., Karachi. The subjects were allowed to rest for a while and then pulse rate blood pressure was measured using mercury sphygmomanometer and stethoscope The systolic and diastolic blood pressure were noted according to the recommendations of American Heart Associations[15]. After measurement of blood pressure each subject was given a standard breakfast consisting of two slices of bread, one scrambled egg, one teaspoonful of jelly, one teaspoonful of butter and 200 ml of milk. The subjects were advised to take the breakfast within 15 minutes. Blood pressure

measurements were repeated at 15, 30, 45 and 60 minutes after the start of the meal. Pulse pressure was calculated as the difference between systolic and diastolic pressure. Mean arterial pressure (MAP) was estimated according to the following formula 10:

$$MAP = (2\ DBP + SBP)/3$$

Where:

MAP = mean arterial pressure
DBS = diastolic blood pressure
SBP = systolic blood pressure

Pulse rate was counted by the recommended clinical method, by placing the tips of the fingers on the radial artery while the forearm of the subject was pronated with slightly flexed wrist. Each time the pulse was counted for exactly one minute. The results were subjected to standard statistical methods.

RESULTS

The mean values for the pre-prandial and postprandial systolic pressure, diastolic pressure, mean arterial pressure, pulse pressure and pulse rate, in young adults group, are given in table 1. There was no significant difference between the pre-prandial mean values and postprandial mean values for systolic pressure, diastolic pressure and mean arterial pressure. Postprandial pulse pressure showed significant increase at first 15 and 30 postprandial minutes but this also returned to almost pre-prandial level in next 30 minutes. The pulse rate in this group, however, showed significant increase after meals.

Table 1-Preprandial & Postprandial! Systolic Blood Pressure, Diastolic Blood Pressure, Mean Arterial Pressure, Pulse Pressure & Pulse Rate In 20 Young Adults

	Systolic Pressure (mmHg)	Diastolic Pressure (mm Hg)	Mean Arterial Pressure (mm Hg)	Pulse Pressure (mm Hg)	Pulse rate (Beats/min)
Preprandial	115.35 ± 2.11	76.50 ± 1.54	89.45 ±.65	38.85 ± 1.23	68.2 ± l.28
15 minutes postprandial	116.40 ± 1.95	73.20 ± 1.54	87.60 ± 1.61	43.2 ± l.60*	70.25 ± l.24
30 minutes postprandial	115.50±2.02	70.70±1.42	85.63±1.58	44.80i0.96 ***	74.1 ± l.21 **
45 minutes postprandial	114.95 ± 2.14	73.15 ± l .46	87.08 ± 1.65	41.8 ± l.04	74.15 ± l.20 **
60 minutes postprandial	114.80 ± 2.14	75.25 ± 1.31	88.43 ± l.51	39.55 ± l.34	71.8 ± l .19*

(* $p < 0.05$, **$p < 0.01$, **$p < 0.001$ as compared to preprandial mean.

The mean values for the preprandial and postprandial systolic pressure, diastolic pressure, mean arterial pressure, pulse pressure and pulse rate are shown in table 2. There was significant reduction in all the pressures after ingestion of meal in this group while the pulse rate showed no significant change.

Table 2-Preprandial &Postprandial Systolic Blood Pressure, Diastolic Blood Pressure, Mean Arterial Pressure, Pulse Pressure & Pulse Rate In 50 Elderly Adults

	Systolic Pressure (mmHg)	Diastolic Pressure (mm Hg)	Mean Arterial Pressure (mm Hg)	Pulse Pressure (mm Hg)	Pulse rate (Beats/min)
Preprandial	125.08+1.44	78.92±0.83	94.42±1.00	46.50 ± 0.84	74.14 ±l.44
15 minutes postprandial	119.08±1.51	75.76+0.85	90.13±1.02	43.54 ± 0.93	74.62 ± 0.59
30 minutes postprandial	114.12±1.45	73.98±0.78	87.36 ± 0.96	39.94 ± 0.94	75.28±0.67
45 minutes postprandial	113.48± 1.37	73.02±0.76	86.5±0.99	40.52±0.93	74.20±0.58
60 minutes postprandial	116.08 ±l.23	73.50 ± 0.74	87.69 ± 0.84	42.64 ± 0.90	73.78 ± 0.54

(*p < 0.05, **p <0.01, ** p <0.001 as compared to preprandial mean)

Table 3-Differences in different pressures and pulse rate after meal in young adults and elderly subjects

		Preprandial vs 15 minutes postprandial	**Preprandial vs 30 minutes postprandial**	**Preprandial vs 45 minutes postprandial**	**Preprandial vs 60 minutes postprandial**
Systolic Pressure	Young adults (n=20)	+ 1.05 ±0.56	+0.15 ±0.72	-0.40 ±0.58	-0.55 ±0.60
	Elderly subjects (n=50)	-6.34 ±0.49*	-11.30 ±0.48*	-11.94 ±0.63*	-9.34 ±0.69*
Diastolic Pressure	Young adults (n=20)	-3.30 ± 0.42	-5.80 ±0.48	-3.35 ±0.63	-1.25 ±0.67
	Elderly subjects (n-50)	-3.16 ±0.19	-4.94 ±0.23	-5.90 ±0.21 *	-5.42 ±0.28*
Mean Arterial Pressure	Young adults (n=20)	-1.85 ±0.32	-3.82 ±0.43	-2.38 ±0.48	-1.00 ±0.47
	Elderly subjects (n=50)	-4.29 ±0.26*	-7.06 ±0.25*	-7.91 ±0.27*	-6.73 ±0.28*
Pulse Pressure	Young adults (n=20)	+4.35 ±0.73	+5.95 ±0.79	+2.95 ±0.85	+0.70 ±0.94
	Elderly subjects (n=50)	-2.96 ±0.50*	-6.56 ±0.52*	-5.98 ±0.64*	-3.86 ±0.78*
Pulse Rate	young adults (n=20)	+2.05 ±0.28	+5.90 ±0.37	+5.95 ±0.37	+3.60 ±0.42
	Elderly subjects (n=50)	+0.48 ±0.31*	+ 1.14 ±0.54*	+0.06 ±0.34*	+0.36 ±0.26*

(*p < 0.05. **p <0.01, ** p <0.001 as compared to young adults)

Table 3 is showing the comparison between the magnitudes of differences in different pressures and pulse rate after meals in the young adult group and the elderly subjects group. The changes in different pressures and heart rate after meal in the elderly people were found to be

statistically highly significant when compared to the respective changes in young adults (p value less than 0.001) except the changes in diastolic pressure at 15 and 30 minutes after meal where the differences produced after meal in elderly people were not significantly different as compared to the same in the young adults.

DISCUSSION

The results of this study demonstrate that the elderly people have moderate to marked decline in the blood pressure after ingestion of meal that does not occur in the normotensive young adults. The blood pressure and the heart rate changes after meals in young adults have appearance of stimulation of sympathetic nervous system similar to that which occur on assumption of upright posture. The sympathetic nervous system stimulation, mediated through baroreceptor reflexes, results in an increased peripheral resistance and heart rate[16]. For blood pressure homeostasis there are several interrelates systems which perform their specific functions to control or regulate the blood pressure. The most rapidly acting mechanism for this purpose is the arterial baroreceptor control system which functions to regulate, minute to minute, second to second or even more rapidly occurring variations in the arterial pressure[1'] Baroreceptors are the buffering mechanism against acute increase or decrease in blood pressure. The acute blood pressure decreases are buffered more efficiently than acute blood pressure increases[5]. This is because of the fact that in normotensive subjects, the baroreceptors discharge at basal blood pressure, near their maximum level, thus allowing the decrease in baroreceptor activity induced by a decrease in carotid sinus transmural pressure, to be greater than the increased baroreceptor activity induced by an increase in carotid sinus transmural pressure[18]. In the elderly people the baroreceptor activity is reported to be reduced. Gribbin et al. and Sundlof and Wallin demonstrated that a progressive and significant decrease in baroreflex sensitivity occurs with the increasing age[7,6]. This may occur either because of reduced dispensability of the vessel wall in the baroreceptor area[17] or baroreceptor degeneration with the increasing age[8,9] or both. This may be the reason that the elderly subjects of our study showed poor circulatory adjustments, with reduction in the blood pressure without compensatory increase in the heart rate, in response to postprandial decline in blood pressure due to increased splanchnic blood flow after meals which has been reported by Vatner et al.[20] and Brandt et al.[11].

Postural hypotension occurs frequently in the heathy elderly subjects and in patients on antihypertensive therapy and such subjects may be particularly likely to have the symptoms of hypotension or postural hypotension in the postprandial periods[10]. The elderly subjects have a defective vasomotor control and compensate poorly for sudden changes in cardiac output It is possible, therefor, in such subjects that further impairment of vasomotor function related to meal may significantly decrease the blood pressure and/or cerebral blood flow.

Eating may also affect blood pressure homeostasis in the elderly through insulin induced blunting of the baroreceptor sensitivity because of oral glucose ingestion[14]. Insulin administration has been shown to impair baroreflex mechanism by Page and Watkin[22] and Rowe et al.[23]. Rowe et al.[24], Bannister et al.[25] and Minaker et al.[26] had also demonstrated glucose and insulin infusion leads to increase in plasma nor-epinephrine level in young people whereas no change in plasma nor-epinephrine level in the elderly people could be detected. Postprandial reduction in blood pressure in the elderly may, therefore, in part reflect a failure of sympathetic nervous system activation in response to insulin in them.

Postprandial blood pressure reduction may become clinically important when added to

hypotensive effects of certain medications or postural changes. The identification of postprandial hypotension must be kept in mind in the clinical evaluation of elderly patients with a history of falls, dizziness and syncope. It is possible that in some cases postprandial angina pectoris may arise because of reduced perfusion pressure associated with food ingestion.

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