

A STUDY ON PHYSIOLOGICAL CHANGES IN ESSENTIAL HYPERTENSION AND RHEUMATOID ARTHRITIS WITH REFERENCE TO THE LEVELS OF CORTISOL, BLOOD GLUCOSE, TRIGLYCERIDES AND CHOLESTEROL

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Abstract: The levels of plasma cortisol, blood glucose, serum triglycerides (TG) and total cholesterol (TC) were estimated in 175 human subjects (50 normal controls, 65 having essential hypertension and 60 suffering from rheumatoid arthritis). The results showed a significant elevation in the levels of plasma cortisol and blood glucose in both the stressed clinical groups with respect to controls. Increased levels of atherogenic lipids (TG and TC) were also observed in diseased group. However, in rheumatoid arthritis the biochemical changes were comparatively more pronounced than in hypertensives. The findings *in vitro* reveal that rheumatoid arthritis is a relatively more chronic and late onset disorder, since the functional performance of hypothalamo-pituitary-adrenocortical (HPA) axis declines with chronicity and the efficacy of adrenocortical response to return to normalcy becomes impaired.

Key words: stress glucocorticoid HPA axis homeostasis

INTRODUCTION

Essential hypertension and rheumatoid arthritis are the disorders wherein stress play a cardinal role in their pathogenesis (1). Stress as defined by Selye, is the non-specific response of the body to any demand made upon it (2, 3). Stress response consists of a series of neurohumoral endocrine and metabolic alterations with related physiological changes involving almost all body parts and systems albeit to varying degrees (4, 5). Normally these stress induced

physiological changes are adaptive, compensatory and self limiting but when stress events are frequent, intense and override certain limits, these physiological changes become rather irreversible and pathological in nature (6). Adrenal cortex plays a key role in the stress responses. The HPA axis finds a cardinal position in a stress physiology. Cortisol, a principal adrenal glucocorticoid in man, has multifarious effects in health and disease (7). The principal effects of cortisol are to reduce inflammation, stabilize blood glucose, maintain muscle strength and fluid excretion. Cortisol exerts

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profound effects on blood pressure and cardiac output. Hypercortisolism play a dominant role in lipid and glucose metabolism. Keeping all these points in view, present study was undertaken to evaluate the levels of cortisol and certain metabolites in the above mentioned disorders.

METHODS

Investigations were carried out on blood sample taken from normal controls and subjects suffering from essential hypertension and rheumatoid arthritis. The number of subjects studied were 175 (50 controls, 65 with essential hypertension and 60 suffering from rheumatoid arthritis). All the subjects belonged to middle socio-economic class families and were aged 35-50 years and were attending the outpatients department. Prior to their participation in this study, all these patients were thoroughly examined by clinicians to rule out any associated diseases. The

the levels of biochemical parameters in both the stressed clinical groups in comparison with those of control values (Table II). Plasma cortisol and blood glucose values were quite enhanced in cases of rheumatoid arthritis. The significant elevations ($P < 0.01$), 23% and 65.6% were noted for plasma cortisol and blood glucose respectively in arthritis subjects. Compared to normal controls, the subjects of essential hypertension exhibited relatively less physiological aberrations as is observed in arthritis. As regard the TG and TC, they were found more elevated in arthritis subjects with respect to normal controls.

DISCUSSION

Cortisol, a principal glucocorticoid in man secreted by glomerular cortices of the adrenal gland, an integrated part of HPA axis, has a significant role in stressed clinical states. It is an important hormone which suppresses inflammation and serves as autacoid

TABLE I : Physical characteristics of subjects under study.

Groups	No. of subjects	Age (yr)	Height (cm)	Weight (kg)	Blood pressure	
					Systolic (mm/Hg)	Diastolic (mm/Hg)
Normal Control	50	38.4±4.2	168.6±6.4	63.7±7.5	126.0±4.2	78.5±4.6
Essential Hypertension	65	41.6±6.2	169.0±8.5	62.8±5.7	186.0±10.4	97.6±8.4
Rheumatoid Arthritis	60	42.5±7.1	168.4±8.2	62.2±6.3	138.0±9.2	85.5±6.7

subjects were vegetarian and acclimatized to the climate of North India. During the study each subject was asked to fill in a proforma containing detailed information about his stressful life circumstances. Anthropometric measurements were recorded together with age and blood pressure (Table I). Blood was taken in supine state of the subjects from antecubital vein between 0900-1000 h after an overnight (12-14 h) fast. Plasma cortisol was assayed fluorimetrically as per method of Mattingly et al (8). Blood glucose and total serum cholesterol were estimated by procedures of King and Wootton (9, 10) whereas triglyceride was estimated by method of Laurell (11).

RESULTS

Laboratory data showed a significant change in

under stressful conditions. Hypercortisolism under stressful circumstances is an adaptative natural response which helps to maintain fluid excretion and muscle strength and provides surplus body fuels (glucose and lipids) in circulation to avoid exhaustion of the body through the process of hepatic gluconeogenesis and related mechanisms (12). Furthermore cortisol exerts inhibitory action on insulin action. This aggravates the magnitude of stress-hyperglycemia (13). Hypersecretion of cortisol is associated with hyperlipidaemia as is evident from laboratory data (Table II). Clinical data show a significant hike in the levels of triglycerides and total serum cholesterol content in the diseased subjects. However, present study shows a relatively more pronounced elevations in the levels of plasma cortisol and blood glucose in arthritis as compared

to hypertensive patients. Thus, the results *in vitro* studies establish that rheumatoid arthritis is a chronic and late onset, stressful disorder because adrenocortical response declines with chronicity of stressful states (14). Prolonged and recurrent exposure to stress disrupts the efficacy of HPA axis which modulates the cortisol secretion (15). Hypercholesterolaemia in the stressed clinical state could be an antecedent of atherosclerosis which leads to various cardiovascular complications.

The results suggest caution in the treatment of inflammatory disorder with corticoids, as stress-induced hypercortisolism together with additional therapeutic doses administered may result in hyperglycemia and subsequently into diabetes mellitus. Furthermore hyperlipidemia could be a prelude to atherosclerosis in patients already ailing from essential hypertension.

TABLE II : Laboratory data in normal control and diseased subjects.

(Data are Mean \pm SD)

Groups	Plasma cortisol ($\mu\text{g/dl}$)	Blood glucose (mg/dl)	Triglycerides (mg/dl)	Total serum cholesterol (mg/dl)
Control (50)	11.2 \pm 1.4	76.4 \pm 6.7	132.6 \pm 18.3	206.6 \pm 22.8
Essential	18.6 \pm 1.9*	104.6 \pm 10.2**	146.4 \pm 17.2	228.4 \pm 24.4
Hypertension (65)	\pm 1.9	\pm 10.2	\pm 17.2	\pm 24.4
Rheumatoid Arthritis (60)	26.7 \pm 2.3*	126.5 \pm 12.8**	182.8 \pm 20.6	276.0 \pm 24.8

Number of subjects (n) are shown in parentheses.
 * IP < 0.01
 ** IP < 0.05

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