Autonomic Nervous Function in Obesity

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DEDICATION

To My Family

بسم الله الرحمن الرحيم

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ABBREVIATIONS

BMI	=	Body mass index
WHR	=	Waist-Hip-Ratio
AGR	=	Android-Gynoid Ratio
VMH	=	Ventromedial hypothalamus
NIDDM	=	Non insulin dependent diabetes mellitus
DBH	=	Dopamine ß-hydroxylase
FFM	=	Fat-free mass
VMA	=	Vanilmandelic acid
MHPG	=	3 methoxy 4 hydroxy phenylethyleneglycol
Tyr	=	tyrosine
Tryp	=	Tryptophan
NAA	=	Neutral amino acid
HR	=	Heart rate
Sup.	=	Supine
Stand.	=	Standing
After CM	=	After carotid massage
NE	=	Norepinephrine
E	=	Epinephrine
Ht.	=	Height
Calc. %	=	Calculated percentage

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Obesity a common and important health hazard is associated with an increased incidence of hypertension, congestive heart failure and unexplained sudden death as well as an overall increase in mortality rate. Nevertheless the causes of most cases of human obesity are still unknown.

Since, the autonomic nervous system is involved in energy metabolism, alteration in the autonomic function may promote obesity or account for several clinical consequences of obesity.

Most of the present knowledge of autonomic function in obesity comes from studies in animals. Much less is known about the status of autonomic nervous system in human obesity.

This work is designed to study the autonomic nervous system in healthy obese subjects. Such study may affect the management by diet alone or treatment with drugs.

REVIEW OF LITERATURE

Definition of Obesity

Definition of Obesity

Obesity usually is defined as the presence of an abnormally large amounts of adipose tissue. In male aged 18, approximately 15 to 18 per cent of body weight is fat. The corresponding figure for female is 20 to 25 per cent. Obesity has been also defined as body fat content greater than 25 per cent of total body weight for men and greater than 30 per cent for women **(Bray, 1976)**. The problem with this definition is that body fat is difficult to be measured in the clinical setting. It therefore would appear reasonable to define overweight as a body mass index (BMI) greater than about 27 kg per m^2 **(Allen et al., 1956)**. Body mass index is the weight divided by $(\text{height})^2$. **Garrow and Webster** (1985), recently have suggested that the BMI actually is a measure of body fat related to height rather than per cent of body fat and that this is a better measure of obesity than percentage body fat. **Sims (1976)**, suggested that lacking of an individual to burn off excess calories predispose to obesity.

Determination of Body Fat and its Distribution

Laboratory Methods

Under Water Weighing

According to the principle of Archimedes, the volume of an object can be determined from the difference between its weight in water and its weight in air. Thus, body volume can be measured by under water weighting after correction for lung volume, and the body density can be calculated by dividing body weight by volume. Then the fraction of the body that is fat can be calculated from the following formula.

$$\text{Per Cent fat} = \frac{4.95}{\text{density}} - 4.50 \qquad \text{(Siri, 1961)}$$

This method requires that a person be totally immersed and be relatively comfortable underwater, because it usually is done after a complete exhalation at residual lung volume. It has been estimated that there is a 3 to 4 per cent error in predicting body fatness from density (**Lohman, 1981**).

Other New Techniques

Both computed tomography scanning and nuclear magnetic resonance imaging can distinguish between the fat and lean tissues of the body. Because both of these scanning techniques produce data for localized areas of the body, they probably will find more use in the quantification of regional fat distribution than in determination of whole body composition (**Fujoka et al., 1987**).

Clinical and Field Methods

Weight and Height

The most commonly used anthropometric measures in obesity clinics and medical practice are weight and height.

They have the advantages of wide availability of equipments, ease and accuracy of use and general acceptability to patients. In fact most patients define obesity on the basis of body weight. The basic problem with these measures is that body weight is strongly correlated with body height and, for this reason, is not a good measure of body fat. Two basic approaches have been used to overcome these difficulties. The first is relative weight. This approach, which has been popularized by the insurance industry, involves dividing the patient's weight by a standard weight that is based on the patient's height. The second basic approach is the weight-height index. This is defined as the weight divided by some power of height (W/HP) **(Benn, 1971).** The power function (P) is selected for a population to give the maximum correlation with body fat and minimum correlation with body height. When P is 2, the result is the body mass index or Quetelet index (kg per m^2). For most clinical purposes, a standard value of 2 for P is more practical **(Leonhirdt et al., 1987).**

Skin Folds

Skin folds thickness measurement passes many of the same advantages as weight and height measurement. Skin fold used to measure fat distribution. **Muller and Stallones (1981)**, used principal component analysis to evaluate skin fold data. The skin fold could be separated into 2 groups, the first of which consisted of sums of skin folds and related closely to body fatness. The second component of skin fold data consists of difference between trunk and extremity skin folds and was termed the fat patterning index.

Circumferences

The measurement of body circumferences with a tap measure provides the same advantage of portability, ease and acceptability as skin fold thickness. Circumferences measurement appear to be more precise and less subject to interobserver errors than skin fold determination **(Bray et al., 1978)**. The abdominal or waist circumference is measured with a flexible tap placed in a horizontal plane at the level of the natural waist line or narrowest part of the torso as seen from the anterior view. The gluteal (hip) circumference is measured in the horizontal plane at the level of maximal circumference including the maximum extension of the buttocks posteriorly.

Prospective studies in Gothenburg, Sweden, have shown that both men and women who have a high ratio of waist to hip circumferences have increased risk of death, stroke and ischaemic heart disease **(Larson et al., 1984)**. Studies have shown that a greater WHR (Waist-Hip-Ratio) is associated with high blood pressure, glucose intolerance and high serum lipid level **(Krotkieuski et al., 1983)**. It therefore is possible to characterize obese patients on the basis of the ratio of the basis of the ratio of the circumference of the abdomen or waist to the gluteal region or hip (AGR, also android-gynoid ratio). It long has been noted that people differ with respect to the location of fat deposition (**Vague, 1956**). In particular, men tend to have more abdominal fat, giving them the android or male pattern of fat distribution. Women, on the other hand, tend to have greater amounts of gluteal fat and thus have larger hip circumferences, giving them the gynoid or female pattern of fat distribution. Patients with an elevated ratio (for example greater than 0.9 for men and 0.8 for women) are said to have male pattern of obesity, while patients with low ratio (AGR) are said to have gluteal or female pattern of obesity (**Gray and Bray, 1988**).

Fat Cell Size and Number

The number of fat cells can be estimated when there is a measure of total body fat and an estimate of average fat cell size (**George, 1989**). Because fat cell differ in size from one region to another, a reliable estimate of the total number of fat cells should be based on the average of fat cell size from more than one location. The upper limits of normal fat cell number ranges from 40 to 60 x 10^9 cells in adult (**George, 1989**). Onset of obesity in the childhood usually is associated with hypercellularity of fat tissue (**Bjorntorp, 1985**). In contrast, obesity that occur during