HEAT STROKE AND ITS EFFECTS ON DIFFERENT BODY SYSTEMS

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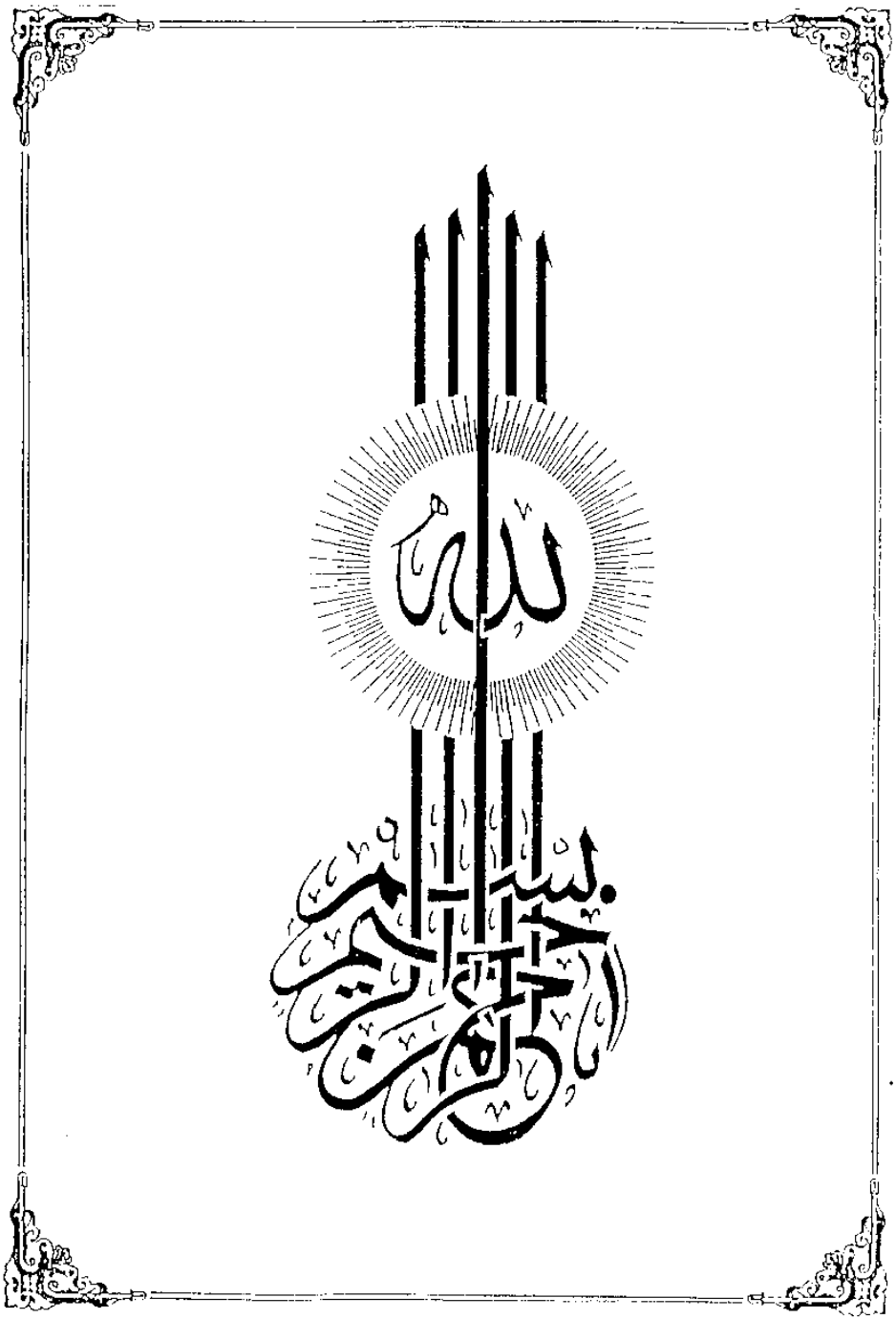

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INTRODUCTION
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INTRODUCTION AND AIM OF THE ESSAY

Heat stroke is an acute medical emergency. The unconscious hyperpyretic patient (rectal temperature of 41 to 43 C^{o}) is in grave danger of death **(Gauss & Meyer, 1917 and Malamud et al., 1946).**

Heat stroke is caused by excessive heat storage when high ambient temperature prevents heat dissipation by radiation or convection and sweat evaporation is limited by humidity **(Stonehil & Keil 1961 ; O. Donnell, 1971 and Adams, 1975).**

This disorder occurs in those exposed for considerable periods to unusually high environmental temperature independent of exposure to direct sun light. Heat stroke occurs due to, excessive body heat per se; any mechanism, which increases body temperature to the point where heat dissipation becomes insufficient can cause heat stroke **(O. Donnell, 1971 and Rose, 1980).**

The danger of heat stroke has apparently always accompanied unacclimatized man on his way through arid zones, and was often the cause of

man's fatal adventures in the desert **(Shibolet et al., 1976).**

Large numbers of unacclimatized urban dwellers have suffered when the urban areas have been involved in heat waves, heat stroke has also been a major problem in hot industrial environments, **(Shibolet et al., 1976).**

The importance of this essay appeared because heat stroke represents an important challenging problem during pilgrimage (Hajj) as a major sector of pilgrims are old and come to Mecca for Hajj where the environmental conditions are different from their native origin.

Many groups of pilgrims of different countries gather in one place for the same purpose at the time of pilgrimage, which takes place for several years in summer time at which temperature might reach up to fifty degrees centigrade and upward, meanwhile, the humidity is very great the thing which makes the possibility of getting heat stroke very possible, causing a great death among pilgrims **El-Halawani, 1964; El-Ansary, 1974 and Wahib et al., 1984).**

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Among the vulnerable groups for this disorder are: football players in hot climates, military forces especially recruit troops under training in summer time, Egyptian farmers do their work daily under sun rays, and our workers in our various factories such as iron and steel factories, glass-factories, smithers drilling for oils in vast deserts, coal-miners, stonecutters, woodcutters, builders, road menders, railway menders, reclaiming desert, bakeries and boiler rooms of steam ships **(Berry & King, 1962 and El-Ansary, 1974).**

This essay is not strictly confined to the items mentioned in protocol, but it also dealt with new topics e.g. Heat stroke in astronauts, heat stroke in the aged and in infancy; and biochemical changes in rhabdomyolysis due to heat stroke.

Wahib; El-Naggar; Hussien and Aly (1984) from Tropical Medicine (Ain Shams University) studied the clinical presentations and laboratory changes in pilgrims during pilgrimage at Mina and Arafat in Saudi Arabia.

REVIEW OF LITERATURE

PHYSIOLOGY OF BODY TEMPERATURE AND ITS REGULATION

Animal species are commonly described as either 'cold-blooded' or 'warm-blooded' **(Bell and Smith, 1980).**

Animals capable of maintaining their body temperature almost constant inspite of the wide variations in the environmental temperature are called homeothermic 'warm-blooded' animals e.g.: mammals and birds **(Talaat, 1972; Hamdi et al., 1985 and Ganong, 1985).** On the othr hand animals whose body temperature changes according to the temperature of the environment are called poikilo-thermic (cold-blooded) animals e.g. reptiles **(Bell, Smith 1980 and Hamdi et al., 1985).**

Man is homeothermic: that is, his central body temperature does not change with changes in the external temperature **(Roddie, 1984).**

In man the body temperature is regulated within a very narrow range. Obviously, the mechanisms for control of body temperature represent a beauti-

fully designed control system **(Guyton, 1985 and Hamdi et al., 1985).**

The body temperature is almost maintained at an optimal level for cellular enzymatic and biologic activity; the body temperature is almost kept constant at about 37^{o}C; for every 1C^{o} change in cellular temperature, metabolism is altered about 20% **(Hamdi et al., 1985 and Ganong, 1985).** The body temperature increases, the rate of nerve condition, cardiac pace maker activity, muscle contraction and cellular metabolism increase.

At body temperature 41^{o}C nerve malfunction convulsions and protein denaturation occurs. The absolute limit for life is 43 ^{o}C **(Hamdi et al., 1985 and Ganong, 1985).**

When speaking of the body temperature regulation, one usually means the temperature in the interior, called the core temperature and not the temperature of the skin or tissues immediately underlying the skin. The surface temperature, in contrast to the core temperature, rises and falls with the temperature of the surroundings. This is the temperature that is important when we refer to

the ability of the skin to lose heat to surroundings **(Guyton, 1985).**

In general, man is a tropical homeotherm who without the protection of clothing and shelter can not tolerate cold climates as do many birds; on the other hand man can live and work even in hot dry desert environments, where his total heat gain by convection and by radiation from sun ground may far exceed his resting metabolic heat production **(Robinson and Wiegman, 1984).**

In fact, because of its superior importance regulation of body temperature is given priority over other vital regulatory functions e.g. in hot weather *profuse sweating continues inspite of* dehydration and disturbance in electrolyte balance **(Talaat, 1972).**

THE NORMAL BODY TEMPERATURE

No single temperature level can be considered to be normal, the body temperature varies somewhat with excercise and with extremes of temperature of the surroundings because the temperature regulatory mechanisms are not 100 per cent effective **(Guyton, 1985).**

The measured body temperatures are oral, rectal, and in some cases axillary. Oral and axillary temperatures are about 0,5°C lower than rectal temperatures and are subjected to greater variations as they are affected more by the surrounding air temperatures **(Talaat, 1972 and Hamdi et al., 1985).**

The skin temperature is called the shell temperature, while the rectal temperature represents the main temperature of the deep body structures and aorta and called core temperature **(Bell & Smith, 1980 and Hamdi et al., 1985).**

There is considerable difference between the core (rectal) and shell (skin) temperatures. In an adult healthy person at a comfortable room temperature (24-25°C); the rectal temperature is about

33 ^{o}C **(Hamdi et al., 1985).** Children tend to have higher temperature than adults and their temperatures vary more and these fluctuations in body temperature of 1 ^{o}C or 2 ^{o}C in newly born infants are due to immature regulatory mechanisms **(Bell, Smith 1980 and Hamdi et al., 1985).**

Heat gain is due to :

I- **Heat production in the body :**

Heat is produced in the body by metabolic reactions, the basal level of heat production represents the energy required for the vital organs as heart, lungs, brain, and abdominal organs; the basal heat production can be increased as a result of skeletal musclar contraction or the action of several hormones and specific dynamic action of food **(Ganong, 1985 and Hamdi et al., 1985).**

At comfortable temperature (24 ^{o}C-32 ^{o}C); the maintenance of the body temperature occurs through vasomotor mechanism **(Hamdi et al., 1985).**

Changes in muscle activity in the form of general and gradual increase in skeletal muscle tone lead to shivering; shivering consists of synchronous contraction and relaxation of small