بسم اللّه الرحمن الرحيم

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التوثيق الإلكتروني والميكروفيلم

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نقسم بالله العظيم أن المادة التي تم توثيقها وتسجيلها علي هذه الأقراص المدمجة قد أعدت دون أية تغيرات

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INADVERTENT POSTOPERATIVE HYPOTHERMIA IN NEUROSURGICAL PATIENTS

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PHYSIOLOGY OF TEMPERATURE REGULATION

Homeothermy

Homeothermy is defined by the Thermal Physiology Commission of the International Union of Physiological Sciences as a pattern of temperature regulation in which the cycle variation in core temperature is maintained within arbitrary limits of +2 °C despite much larger variations in ambient temperature.[1] Only mammals and birds conform to this definition, however, all other vertebrates exhibit some degree of thermal regulation, mediated usually by behavioral responses.[2]

Homeothermy involves sensing body temperature and appropriately driving the mechanisms controlling heat loss and gain so as to maintain a normal value for temperature. Thus thermoregulation is a closed loop system.

Thermal balance

Homeothermy is achieved by balancing heat gain with losses within a range of ambient temperature. This may be achieved without metabolic expenditure, by the control of peripheral vasculature. Beyond the limits of this thermoneutral zone (approximately 20-35 °C in resting adults); energy must be expended in order to maintain thermal balance.

Heat gains

These can be considered as obligatory or facultative. Obligatory heat gains are those occurring independently of thermoregulation and imposing demands upon it. This includes the heat derived from basal metabolism, feeding, storage and growth. However, the major source of metabolic heat is muscular exercise. Light exercise (walking) results in a 3-5 fold increases in metabolic rate above basal and severe exercise can produce up to 20 fold increases.

Facultative heat gains are those available to thermoregulation as a mean of restoring thermal balance and may be classified as shivering and non-shivering.

1. Shivering may produce 4-6 fold increases in heat production.[3] 80% of heat produced is retained by the body, compared with 50% for voluntary exercise.

2. Non shivering thermogenesis is any source of facultative heat production other than shivering.

Neonates have large quantities of brown adipose tissue over the neck, upper part of the back and around thoracic and abdominal viscera. Activation of brown adipose tissue in human neonates may cause 2-3 fold increases in metabolic rate. Brown fat is controlled by the hypothalamus via sympathetic nerves and circulating catecholamines. In humans older than 1 year, brown fat is probably unimportant as a source of heat production.[4]

Heat losses

Heat is lost from the body only at points of contact with environment, that is the skin and the respiratory tract. At rest, 75% of basal heat production is lost by convection, conduction and radiation from the body surface. Of these, convection is the largest component and conduction is usually minimal. Losses by insensible perspiration and through the respiratory tract account for the remaining 25% in approximately equal amounts. Sweating is the major source of heat loss under thermoregulatory control. The maximum rate of sweating is of the order of 2 L /hr. This gives a calculated heat loss of about 2.7 MJ/ h or about 15 times basal heat production. Sweating is exhaustible and maximum sweat production about 5 litres.

Heat storage

The body is not in a continuous state of heat balance, net gains or losses result in changes in the overall heat content of the body, normally with little or no change in the core body temperature. This is brought about by changes in the temperature of the body shell (those parts of the body in contact with the environment and hence usually at a lower temperature than the body core).

Temperature Receptors:

There is growing evidence that temperature receptors exist in many body tissues. They can be classified into two main groups: central, which sense the temperature of the body core, and peripheral, which sense the temperature of the body shell and environment.

Central Thermoreceptors:

It is well recognized that the anterior hypothalamus is temperature sensitive and it was thought that the hypothalamus contributes to more than 60% of the total thermoreregulatry input.[5,6]

More recently, it has become apparent that many body tissues contain temperature receptors, including the spinal cord, given stimulus may provoke one of several different effector responses. For example, in animal experiments, cold stress may result in the behavior response of selection of a warm environment or the automatic response of shivering.[7]

The role of the hypothalamus in themoregulation is often likened to a thermostat, however the biological correlate of the thermostatic set point remains unknown.

There is no evidence for a neural reference signal with which the integrated thermal input is compared, and it has been suggested that a balance of warm and cold thermal inputs creates a dynamic set point.[7]

THERMOREGULATION DURING GENERAL ANAESTHESIA

Behavioral regulation is not relevant during general anaesthesia since the patient is unconscious and frequently paralyzed.

All general anaesthtics so far tested markedly impair normal automatic thermo-regulatory control. Anaesthetic induced impairment has a specific form:- Warm - response thresholds are elevated, whereas cold response thresholds are reduced. Consequently, the inter-threshold range is increased from its normal values near 0.2 °C to 4 °C. [11]