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SA MILITARY HEALTH SERVICES

COMBATTING DISORDERS ASSOCIATED WITH HIGH TEMPERATURES

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INTRODUCTION

1. The most important climatic variables that must be determined to calculate the degree of heat stress are temperature, humidity, radiation heat, radiation exchange and air environment. It is important that these readings be taken in the same conditions as those in which the members are employed. Certain members are however employed in worse conditions than others, eg in vehicles and combat vehicles. In the SANDF the Commanding Officer of a unit is responsible for implementing and monitoring a warning system in his/her unit.
2. Measures taken to prevent disorders associated with high temperatures, especially during military training and exercises, are of vital importance to ensure that the controllable risks are kept to a minimum. It is vital to identify, as early as possible, the effect high temperatures have on the body so that appropriate treatment could be administered timeously.
3. Since disorders associated with high temperatures can lead to systemic and/or sudden physiological collapse of the body (including death), it is of vital importance that, firstly, the controllable risks are limited to the minimum and, secondly, the clinical condition is recognised as early as possible and that the appropriate treatment is timeously administered.
4. Statistics. From time to time there have been reports of incidences where members of the SA National Defence Force collapsed during training in warm climatic conditions and required intensive treatment. Six cases of heat stress have been reported over the period 1996 to 1998 and two fatalities are known to have occurred over the same period. A further one fatality have been reported due to hypothermia

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(freezing) during border control duties in the Maluti mountains.

DIFFERENTIAL DIAGNOSES OF DISORDERS ASSOCIATED WITH HIGH TEMPERATURES

5. **Hyperpyrexia (malignant hyperthermia)**. This condition results from a possible defect in the calcium transference by the sarco plasmic reticulum of the skeletal muscle, with subsequent muscle rigidity and heat production. Claims are also made that genetically defined diseases are initiated by certain chemical compounds, such as succinylcholine. Characteristics that correspond with those of heat stroke are disturbances in the electrolyte balance and kidney function, intra vascular coagulopathy, an increase in certain plasma enzymes, as well as a disturbance in temperature control. The conditions is particularly prevalent during general anaesthesia and special care must be taken in the operational area to prevent it. It occurs in 1:14 000 to 1:40 000 cases of operations. An indication of malignant hyperthermia is when a patient who is under an anaesthetic suddenly becomes rigid and tachycardia or tachypnoea develops, of when he/she feels warm and the venous blood becomes very dark.

6. **Behavioural Disorders (tropical neurasthenia)**. This is a transitory or chronic condition that results in reduced effectiveness, poor concentration and behavioural disorders. Psychological factors and possible hormonal disorders play a role, although acclimatisation can solve the problem.

7. **Skin Rashes**

- a. Miliaria crystallina is caused by local clogging of sweat glands, which forms small, itching vesiculae due to sweat intrusion into the epidermis.
- b. Miliaria rubra is similar to the above, with sweat intrusion into the dermis resulting in a reddish rash. Both these conditions are important because they could be an indication that a person may develop more serious heat disorders.
- c. **Anhidrotic Skin Affection**. These are specific areas of the skin that do not secrete sweat. The condition frequently follows serious sunburn and occurs in cases with a history of heat disorders. It frequently occurs during war conditions and is also seen in cases of heat stroke.

PHYSIOLOGICAL CONTROL OF BODY TEMPERATURE

8. Energy is released in the body cells by the burning (oxidation) of food. This released energy is used to keep the body's nuclear temperature constant. In

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spite of great variations in environmental temperature, the body temperature remains constant between 37,3EC and 37,5EC (homothermal). Of the daily energy 13 860 kJ expended, 12 600 kJ is released as heat and 1 260 kJ is converted into work performance. The excess heat released is distributed through the body by the bloodstream, which disposes of it as follows:

- a. Heating of ingested food and heating of inhaled air: 460 kJ.
- b. Heat loss through defecation and urination: 210 kJ.
- c. Heat loss from the surface of the skin through:
 - i. Radiation, convection and conduction: 8 820 kJ. This loss is determined by the amount of blood flow through the skin.
 - ii. Unconscious perspiration: 2 100 kJ.
 - iii. Secretion of sweat when it evaporates on the surface of the skin (skin temperature normally 33-34EC). Each gram of sweat requires 2,4 kJ to convert into vapour. This process varies, can be controlled and is the most important cooling mechanism when the body is overheated (heat stress).

9. If the body temperature rises as a result of increased cellular oxidation (muscle activity) or exposure to a high environmental temperature (radiation, convection and conduction from the environment), the following takes place:

- a. Heat-sensitive sensors in the skin transmit impulses to the temperature centre in the hypothalamus.
- b. The increased blood temperature stimulates the temperature centre directly.

10. The temperature centre initiates the following compensation measures:

- a. Nerve impulses to the muscular fibres decrease muscle tone and work is also consciously decreased as a result of a physical perception of heat.
- b. Nerve impulses widen the blood-vessels in the skin in order to increase heat loss by means of radiation, convection and conduction.

- c. Nerve impulses to the sweat glands increase perspiration, resulting in cooling when the sweat evaporates. This cooling will be hampered if the atmosphere is very humid or saturated with vapour.

11. When exercise is very strenuous or the atmosphere is very warm and/or humid, the biological system becomes heat-laden (heat stress). If the body temperature does not normalise, a distortion of the biological system takes place (heat tension), which will lead to overheating, resulting principally in the destruction of enzyme systems and cells of the central nervous system.

12. When a person perspires, there is a loss of water and salt in the body. The body's fluid balance must be restored continuously by taking in equal or larger amounts of water. If a person loses more water than that which he/she supplements by drinking fluids, he/she will eventually stop perspiring and subsequently not be able to dispose of the accumulated heat. The body temperature can become exceedingly high and the temperature centre in the brain can be impeded. The person then becomes seriously ill and may even die.

13. In very warm weather, more than 5 litres of water can be lost per day through perspiration. In order to effectively maintain the fluid balance and health, at least 7 litres of water would need to be consumed daily. In dry desert regions and under very strenuous working conditions, perspiration can cause a loss of as much as 10-15 litres of fluids, which must be supplemented.

PREVENTION OF HEAT DISORDERS

14. If the following aspects are strictly enforced at all times, the occurrence of disorders associated with high temperatures will be kept to a minimum. At the same time, members must be afforded the opportunity to acclimatise sufficiently during training/service:

- a. **Education of Personnel.** The most important preventative measure is the education of personnel in preventing, identifying and the treatment of disorders associated with high temperatures.
- b. Monitoring of the thermal environment.
- c. Acclimatisation.
- d. **Water Intake.** Personnel exposed to heat must consume water frequently, preferably at 10 to 20 minute interval. During training in warm weather,

members must each consume at least 6 litres of water per day.

- e. **Food Intake.** Even though warm weather tends to dampen the appetite, a balanced diet is still very important. Breakfast is indispensable for the supply of energy and the prevention of exhaustion, especially for those who participate in parades and perform other tiring work during the morning. In warm conditions a light lunch should be taken and the main meal should provide for sufficient, correctly balanced rations. Regular normal rations and electrolytes in water will supplement salt loss.
- f. **Clothing.** Apart from other considerations, clothing should protect the body from sunburn, dense vegetation and insects (especially mosquitoes). Clothing impedes the body's cooling process in warm weather and material should have a high vapour permeability and high conductivity. If possible, light clothing should be provided to promote the evaporation and cooling processes. Tracksuits should only be worn during rest periods.
- g. Rest periods during the day and sufficient rests during the night (6 - 7 hours) are important. During operational conditions, rest and sleep periods must be properly rotated. Members who are employed in abnormal environmental conditions must also be rotated (eg in combat vehicles).
- h. Living quarters must be comfortable and cool, and provided with adequate cross ventilation so that those troops can enjoy sufficient rest and non-exhaustive sleep. Preventative measures must also be instituted against insects (especially mosquitoes) that can disturb the night's rest.
- i. Training and strenuous physical exercise must be handled according to the WBGT index, with adjustments to the necessary work and rest periods and water intake. The WBGT index must be calculated and recorded graphically. If the various colour codes are also indicated on these graphs, this system's effect on training will become very obvious. The following table gives an indication when exercise and training must be stopped:

SER No	WBGT INDEX	PRECAUTIONS

	a	b
DURING ACCLIMATIZATION		
1	26.6 - 29.41C	Be careful, regular water breaks, look out for heat related symptoms.
2	29.4 - 31.11C	Activities for unfit and unacclimatized members must be stopped. Restricted activities for fit and acclimitized members. Regular water breaks.
3	31.11C	Stop all activities.
AFTER ACCLIMATIZATION		
4	Above 29.51C	Strenuous exercise to be stopped.
5	Above 311C	Stop all activities
DURING AND AFTER ACCLIMATIZATION		
6		When the wet-bulb reading is within 31C of the dry-bulb reading, all activities should be stopped.
7		When the wet-bulb reading is from 3-51C below the dry-bulb reading, helmets, sweatshirts and shoulder pads should be discarded and activities to be slowed down.

- j. Sport must be limited to the cooler times of day. Between 12:00 and 15:00 activities must preferably be limited to sedentary training and tasks.
- k. Apart from sport and certain other activities, a progressive fitness programme should be followed.
- l. Early identification of contributing factors is important.
- m. Training directives and programmes must include precautionary measures against heat casualties and instructors must be well acquainted with all facets of heat stroke.

THEORY: FACTORS CONTRIBUTING TO DISORDERS ASSOCIATED WITH HIGH TEMPERATURES

15. Determining the Thermal Environment The most important climatic variables (parameters) that must be determined in order to calculate the degree or extent of heat stress are:

- a. Air temperature.
- b. Wind-speed (air movement).

- c. Radiation heat exchange.
- d. Vapour saturation (humidity) of the air. temperature, humidity, radiation heat, radiation exchange and air movement. It is important that these readings be taken in the same conditions as those in which the members are employed. Certain members are however employed in worse conditions than others, eg in combat and other types of vehicles.

16. **Training in All Weather Conditions.** An operationally prepared defence force must be capable of deployment in all types of climatic conditions. Training in adverse climatic conditions eg warm weather would ensure the readiness of such a defence force. However, training under such conditions would have to be controlled as it could result in an unacceptable number of non-combat casualties and an unfavourable decrease in fighting ability of the force which would hamper the success of operations.

17. **Concomitant Environmental Conditions with Physiologic Needs of the Troops under Training.** Measures to prevent disorders associated with high temperatures must meet, with equal importance, both the training and operational needs of the organisation and the physiologic needs of the troops. The proposed measures require the constant monitoring of the environmental conditions under which training is conducted, a system of proper acclimatisation of the troops to warm weather, proper adjustments to work and rest periods and the regular intake of water during training.

18. **The Electrolyte Balance of the Body**

- a. Regular normal rations and electrolytes in water will supplement salt loss. In the case of diarrhoea, additional salt and water can be consumed to maintain the fluid and electrolyte balances.
- b. Instead of coffee and tea, orange juice or moderately concentrated carbohydrate-electrolyte beverage (4-8% carbohydrate) must be freely available during meals since it contains the most elements that are required to maintain the electrolyte balance.

19. **Food.** Even though warm weather tends to dampen the appetite, a balanced diet is still very important. Breakfast is indispensable for the supply of energy and the prevention of exhaustion, especially for those who participate in parades and perform other tiring work during the morning. In warm conditions a light lunch should be taken and the main meal should provide for sufficient, correctly balanced rations.

20. **Clothing.** Apart from other considerations, clothing should protect the body from sunburn, dense vegetation and insects (especially mosquitoes). Clothing impedes the body's cooling process in warm weather and material should have a high vapour permeability and high conductivity. If possible, light clothing should be provided to promote the evaporation and cooling processes. Tracksuits should only be worn during rest periods.

SPECIFIC FACTORS

21. The following factors specifically contribute to the development of disorders associated with high temperatures:

- a. Poor acclimatisation.
- b. Advanced age makes members more susceptible as a result of deficient cardiac reserves. This is especially so if there is associated degenerative cardiovascular disease.
- c. Overweight and obesity in particular leads to the production of more heat (large mass of fibre) for the available surface area (heat loss) thereby compounding the effects of warm weather on the body.
- d. Acute fever-related infections such as gastro-enteritis and malaria (even in the recovery phase) can contribute to the precipitation of disorders associated with high temperatures. The clinical picture of infections can be confused with heatstroke.
- e. The rate of bodily functions accelerates during warm weather and when physical exertion is added to the regime, exhaustion rapidly sets in far more readily than would be the case in mild or cool climatic conditions. Adequate rest periods and sufficient sleep would retard the rate of bodily functions and restore homeostasis.
- f. Recent immunisation, especially associated with immunisation reactions.
- h. Alcohol consumption the previous 24 hours (suppresses ADH secretion, resulting in dehydration).
- l. Deficient diet (salt loss).
- j. **Dehydration.** Caution should be exercised because the onset could be imperceptible:
 - i. 1 kg body wt loss due to sweating is equivalent to 1,4% dehydration.

- ii. 1,5 kg body wt loss due to sweating is equivalent to 2,1% dehydration with a reduction in the circulating blood volume. Physical thirst normally only sets in at 2% dehydration.
 - iii. 2-4 kg body wt loss due to sweating is equivalent to 3-6% dehydration with a perceptible reduction in work ability. During training and military operations, dehydration of up to 2-3% generally occurs.
- k. **Medication.** A combination of the following is of particular importance:
- i. Anticholinergic substances (atropine, scopolamine).
 - ii. Phenothiazine (chlorpromazine).
 - iii. Tricyclic antidepressant substances (amitryptiline, imipramime, nortryptiline).
 - iv. Monoamine oxidation inhibitors.
 - v. Glutethimide.
 - vi. Lysergic acid diethylamide (LSD).
 - vii. Amphetamine.
 - viii. Anaesthetic gases (ether, ethyl chloride, Halothane N₂O).
 - ix. Suxamethonium (succinylcholine).
- l. Chronic disorders such as cardiovascular diseases and diabetes mellitus.
- m. Lesions to the hypothalamus, brain stem and cervical part of the spinal chord.

NATURE OF HEAT CASUALTIES

22. Four clinical syndromes are associated with high environmental temperatures: **heat cramps**, **heat exhaustion**, **exertional heat injury** and **heat stroke**. Although each of these entities may be separated from the others on

clinical grounds, there is considerable overlap between them, and they may be considered as a series of syndromes along a single spectrum.

23. **Heat Cramps.** Heat cramps are the most benign heat syndrome. They are characterised by brief, intermittent, and often excruciating cramping pain and usually follow strenuous exercise in the muscles that have been subjected to extensive work. They may develop in non-acclimatised labourers or in conditioned athletes. External temperatures usually do not exceed the body temperature, and direct exposure to the sun is not necessary. Muscles of the extremities bear the brunt of physical activity and hence show the highest incidence of cramps. Treatment consists of rest in a cool environment and replacement of sodium, potassium and fluid. Prevention of the condition is by liberal salting of food and ample intake of water. Salt tablets are gastric irritants and therefore should not be given.

24. **Heat exhaustion.** This is also called *heat prostration* or *heat collapse* and is probably the most common heat syndrome. Heat exhaustion occurs in two forms: one due to water depletion and the other due to salt depletion. The symptoms arise from a failure of cardiovascular responses to high external temperatures. Water depletion is common in elderly individuals (especially if they are receiving diuretics) or in anyone who has inadequate water intake in a hot environment. Body temperature elevation is common. Salt depletion occurs with inadequate salt replacement. It does not cause hyperthermia and is accompanied by hyponatraemia and hypochloraemia. Both forms of heat exhaustion cause weakness, anxiety, fatigue, vertigo, headache, anorexia, nausea, vomiting, and the urge to defaecate, and faintness may precede collapse.

25. **Exertional Heat Injury.** Also known as *heat collapse* or *heat syncope* the syndrome is rarer than the syndromes discussed above. Heat collapse (heat syncope) occurs in both physically active and sedentary individuals. The onset is usually sudden and the duration of collapse brief. During the acute stage, the patient looks ashen-grey. The skin is cold and clammy. The pupils are dilated. Orthostatic hypotension is common, and the pulse rate is elevated. The duration of exposure and the extent to which sweat is lost determine the treatment, which consists of removing the patient to a cool area and placing him or her in the recumbent position. Spontaneous recovery then usually takes place. Intravenous administration of saline solution is sometimes recommended, administered slowly over 48 hours, although oral replacement of water and electrolytes may be sufficient.

26. **Heat Stroke.** Heat stroke occurs when the temperature centre in the brain no longer functions as desired (i.e. like a thermostat). The condition is the result of exposure to high environmental temperature/humidity and is characterised by:

- a. A high body temperature (rectal temperature of 40,5EC and higher).
- b. A warm skin with anhydrosis or a patient who perspires considerably.
- c. Behavioural disorders such as confusion, irritability and aggression (may be early symptoms).
- d. Hypotension and tachycardia.
- e. Changes in the degree of consciousness, accompanied by comas, convulsions, status epileptics and even opisthotonos or decerebrate rigidity.
- f. Enzyme changes (especially increased *SGOT* and *CPK*).
- g. Headaches, vomiting and faecal incontinence.
- h. Reduced urinary volume, which may contain blood, albumin, ketones, and glucose.

27. The increased temperature is particularly harmful to enzyme systems and the cells of the central nervous system, although pathological disorders are also found in the heart, liver and skeletal muscles. If the condition is recognised at an early stage and treated immediately, and complications are avoided, the prognosis is reasonably good with a 5% mortality rate. Once the patient becomes comatose with a high *SGOT*, the condition is virtually fatal. *SGOT* is probably the best indicator of cellular damage.

PREVENTION IN THE SANDF BY ACCLIMATISATION

28. A person who is transferred to a warm climate from a cool or moderate climate (or even a warm climate in which he/she was physically inactive or reasonably well-protected against heat whilst indoors), tends to perspire a lot more than is necessary at the least exertion. Sweating is the most effective natural way of combatting heat stress. As long as sweating continues, humans can withstand remarkably high temperatures, provided water and sodium chloride (salt) - the most important

physiologic constituents of sweat - are replaced.

29. However, sweating can occur with little or no change in the core temperature of the body. This means that relying on sweating alone to regulate the body's temperature in warm climatic conditions is inadequate and could probably prove dangerous. The body then would need a period of **acclimatisation** which would allow it to cope with high core temperatures by lowering the threshold for sweating i.e. for sweating to occur at a lower core temperature.

30. Progressive exposure to heat and physical exercise over a period of 10 to 14 days will gradually increase the work ability and raise the tolerance for environmental heat stress. Fitness is no guarantee for acclimatisation. It may, however, provide protection as a result of the increased functional capacity of the cardiovascular system.

31. During acclimatisation, exercise should not only be limited to the cooler hours of the day, but the prescribed rest periods and water intake must also be strictly adhered to i.e. 300 to 500 ml every 20 to 30 minutes with a water temperature of 15EC (add flavour) Officers and instructors who conduct training must be on the alert for signs of heat stress during these periods in particular. It is important to remember that a partial loss of acclimatisation takes place through a lack of heat exposure, even after just a few days.

32. Medical personnel must be very involved in training during the period of acclimatisation. Their support will include:

- a. Giving advice and guidance during the training planning cycles.
- b. Regularly maintaining and monitoring the TEMPSTRESS apparatus.
- c. Providing support with regard to hydration, nutrition and vitamin intake.
- d. Keeping a watchful eye over troops during training for symptoms and signs of heat disorders.

33. **Physiological Indications of Acclimatisation**

- a. Partial decline in cardiac output (pulse rate decreases).
- b. Gradual increase in cardiac reserve.
- c. Gradual normalisation of the body's nuclear temperature during exercise (rectal temperature).

- d. Increase in perspiration tempo for 8 to 10 days, followed by a reduction.
- e. Perspiration becomes gradually more hypotonic, presumably because of increased reabsorption of sodium aldosterone in the kidneys during excretion.
- f. Urine osmolality gradually increases for 8 to 10 days and then decreases to normal.
- g. A minimal change takes place in serum osmolality.

34. **Guidelines for Water Intake During Acclimatisation/Strenuous Training**

- a. The temperature of the water must be colder than 20EC, if possible.
- b. Cold or cool diluted orange juice must be readily available, especially during periods of basic training.
- c. The thirst reflex is not a sufficient criterion to determine water intake. Water intake at a specific rate must become routine and must be determined by the clock rather than the degree of thirst, preferably 10 - 20 min intervals.
- d. Small amounts of water consumed regularly is more effective. (Refer to the table in para 37i).
- e. Drink 1 litre of water in the morning, at every meal and before a period of strenuous training (prehydration).
- f. Salt loss is supplemented by a full, normal ration during meals. No additional salt is consumed or added to water. During training in warm weather, members must each consume at least 6 litres of water per day.
- g. Use water like a tactical weapon in operational conditions.
- h. Sufficient water must be consumed to maintain a daily urine discharge of at least 1 litre. Low volumes of urine discharge can lead to the formation of kidney-stones and kidney failure.
- i. Recruits and non-acclimatised members need more water. Climate conditions in vehicles also require a larger water intake than normal.
- j. Remember that no one can adapt to managing with less drinking water.

TREATMENT OF HEAT STROKE

35. **First Aid.** When a member displays signs of over-exertion, behavioural abnormality or anxiety during training, he/she must be withdrawn immediately. If possible, he/she must be allowed to sit or lie down in the shade and to undress. If he/she is conscious, he/she must take small sips of water every now and then. The member must immediately be evacuated by vehicle or air transport to a medical officer or the nearest private medical practitioner for an examination and treatment. The patient must be kept in the shade during the evacuation. If a helicopter (or even a vehicle) is used for the evacuation, the air flow can be used to cool down the patient (eg by opening the doors of the helicopter). If medical assistance is inaccessible, place the patient in the shade in a lying position, sprinkle water onto him/her and fan him/her. This process must be continued during evacuation. It is very important that a member who shows signs of heat stroke or collapses is treated as an emergency and transported to a physician as soon as possible. Quick, effective cooling is vitally important and it must be started immediately and sustained until the rectal temperature reaches 38EC. In short, the emergency treatment therefore entails the following:

- a. **Start treatment immediately.** Undress the patient and have him/her lie down in the shade.
- b. **Sprinkle the patient with water** and rub the water gently over the total skin surface. Do not spray large quantities of water over the patient, as cooling occurs through evaporation.
- c. **Fan the patient.** Stop temporarily if goose pimples appear.
- d. Give the patient small amounts of water to drink every now and then if he/she is conscious.
- e. Apply artificial respiration if the patient stops breathing.
- f. Cool the patient down until the rectal temperature falls to 38EC (even during evacuation) or until a physician takes over.
- g. Obtain full details of the preceding physical exertion and the WBGT index (if available).
- h. If there is not sufficient water, use the available water for drinking purposes and establish skin cooling (evaporation) by using urine. It is sterile.

36. **Further Treatment.** In the sickbay or nearest hospital, the treatment is continued by the physician:

- a. Keep the skin moist and cool with electric fans. As much cold liquids as are needed can be administered orally, since this is the preferred method of

administration as soon as the condition allows it. The rectal administration of ice water also helps with cooling and to restore the moisture balance.

- b. Monitor rectal temperature and stop cooling at 38EC.
- c. Improve peripheral circulation by massaging the limbs.
- d. If the person is shivering or restless, administer 10 mg of VALIUM (diazepam) intravenously. Phenytoin Na or barbiturates can be used for convulsions.
- e. Support of the cardiovascular system against hypotension and moisture loss (systolic pressure below 70 mm HG). Crystalloid moisture is administered in the form of 0,9% saline solution, plasmolyte B, Ringer lactate in 5% dextrose or general rehydration fluid. Within the first 60 minutes, one litre of fluid is administered with 2 - 4 litres in the first 24 hours according to the haematocrit or Central Venous Pressure (CVP). Add 50 ml of 8,5% sodium bicarbonate when necessary.
- f. **Maintaining the Kidney Function**
 - i. Bladder catheterisation with accurate intake and output readings, as well as monitoring of specific gravity and albumin. Content of the urine.
 - ii. Furosemide, 40 mg intravenously, and if no excretion within two hours, a further 100 mg, and after another two hours, a further 250 mg, if necessary.
 - iii. Haemodialysis should be resorted to in extreme cases.
- g. If the PO₂ is less than 65 mm Hg, oxygen must be used with or without a ventilator.
- h. Heparin should be used for intra-vascular coagulation, and fresh blood is indicated for bleeding tendencies.
- i. Consider cortisone in case of an oedema of the brain.
- j. Perform complete laboratory tests.

37. **The most important differences between heat stroke and heat exhaustion are as follows:**

Ser no	Aspect	Heat Exhaustion	Heat Stroke

	a	b	c
1	Time of occurrence	Any hot weather	First sustained heat wave
2	Principally affects	Elderly hypodipsics, young heavy labourers, strenuous athletes, etc	Elderly; infirm; obese; alcoholics; psychotics
3	Principal pathogenesis	Salt or Water loss	Failure of heat loss
4	Contributing factors	Prolonged exercise	Antiperspirants; anticholinergics, phenothiazines, diuretics, neuroleptics; old age; dehydration
5	Skin temperature	Cool	Very warm
6	Skin appearance	Moist and normal	Dry, wrinkled and inelastic (sometimes moist)
7	Body temperature	37 - 38,5°C	39 - 43°C
8	Sweating	Usually present	Absent
9	Water balance	Normal	Thirsty and very dehydrated
10	Behaviour	Passive	Restless and aggressive

11	Nerve control	Normal	Clonic contraction
	i. Muscles	Normal	Clonic contraction
	ii. Stool and urine	Controlled	Loss of control
	iii. Face	Normal	Dilated pupils with vacant look
	iv. Consciousness	Transitory collapse (cardiovascular)	Intense collapse (central nervous system)
12	Respiration	Deep and quick	Irregular
13	Treatment	Fluids and adjusted electrolytes	Prompt body cooling (ice water immersion)