

Heat Stroke: Deadly but Preventable

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A severe wave with temperature as high as 49 °C(120°F) struck southern Pakistan in June 2015. It caused deaths of approximately 2000 people from dehydration and heat stroke mostly in Sindh province and its capital city Karachi. Mr. Asif Shuja former DG of Pakistan Environmental Protection Agency claimed that heat wave was a symptom of global climate change, aggravated by de-forestations, expansion asphalt highways and rapid urbanisation¹. Dunya News reported at least 1360 patients died due to heat stroke in different hospitals of Karachi².

HEAT EXPOSURE SYNDROME:

Four medical disorders comprise a spectrum of illness that can result from exposure to hot environments (1)Heat Cramps(2)Heat Syncope(3)Heat Exhaustion and (4)Heat Stroke. Health conditions that inhibit sweat production or evaporation and increase susceptibility to heat disorders include Obesity, Skin disorders (Miliaria), Reduced cutaneous blood flow(by use of vasoconstrictors and beta adrenergic blocking agents), Dehydration (by use of alcohol and illicit drugs e.g. phencyclidine, LSD, amphetamines and cocaine), Malnutrition, Hypotension and reduced cardiac output, Medications such as anticholinergics, antihistamines, phenothiazines, tricyclic antidepressants, monoamine oxidase inhibitors, diuretics etc. Risk of heat disorder increases with (1) Age (2) Impaired cognition (3) Concurrent illness (4) Reduced physical fitness (5) Insufficient acclimatization etc³.

HEAT STROKE:

Heat Stroke is a life threatening medical emergency that results from failure of thermo-regulatory mechanism. It is imminent when the core (rectal) temperature approaches 41°C or 105°F and presents in one of two forms: (a) Classic heat stroke that occurs in patients with compromised homeostatic mechanisms. (b) Exertional heat stroke that occurs in healthy persons undergoing strenuous exertion in a thermally stressful environment⁴. The hallmarks of heat stroke are cerebral dysfunction with impaired consciousness, high fever and absence of sweating. Morbidity or even death can result from cerebral, cardiovascular, hepatic or renal damage. Persons at greatest risk are the very young, the elderly, and chronically ill and patients receiving medications like anticholinergics, antihistamines, phenothiazines that interfere with heat dissipating mechanism. Laboratory evaluation may reveal dehydration, leucocytosis, elevated BUN, hyperuricemia,

hemoconcentration, lactic acidosis, decreased serum sodium, potassium, calcium and phosphorus. Thrombocytopenia, increased bleeding and clotting times. Urine becomes concentrated with elevated protein, tubular casts and myoglobinuria.

Rhabdomyolysis, myocardial, hepatic or renal damage may be identified by elevated serum creatinine kinase, aminotransferase levels and BUN and by the presence of anuria, proteinuria and hematuria⁵.

TREATMENT OF HEAT STROKE:^{6,7,8}

- Treatment is aimed at rapidly reducing the core temperature (within 1 hour) while supporting circulatory and organ system function to prevent irreversible tissue damage and death.
- Intravascular volume status should be assessed and managed early to reduce the risk of hypovolemic shock.
- Central venous or pulmonary artery wedge pressure should be monitored.
- Five percent dextrose in half-normal or normal saline should be administered for fluid replacement.
- IV fluid administration must be provided to ensure a high urinary output (>50 mL/h).
- Mannitol administration (0.25 mg/kg), and alkalizing the urine (intravenous administration of 250 mL of 4% bicarbonate administration may be needed)
- Cooling methods are evaporative and conductive based. Choice of cooling method depends on which can be instituted the fastest with the least compromise to the overall care of the patient.
- Evaporative cooling is a non-invasive, effective, quick and easy way to reduce temperature. This method is done by placing the undressed patient in lateral recumbent position or supported in hands-and knees position to expose maximum skin surface to the air. Large fans circulate the room air while the entire body is sprayed with lukewarm water (20%) or cold wet sheets are applied to the undressed body. Inhalation of cool air or oxygen is also effective.
- Conductive-based cooling involves immersion into ice-water or cool water. Ice bath (1-5 °C) is effective but usually impractical method due to its limitations (space, patient access and monitoring). Cold water immersion includes cool baths, localized ice or ice slush application (groin, axilla, and neck) and iced gastric lavage and infusion of cool intravenous fluids. Intravascular heat exchange catheter systems as well as hemodialysis using cold dialysate (30-35 °C) have been successful in reducing core temperature.
- Care must be taken to avoid shivering, which will increase internal heat production and inhibit effectiveness of cooling.
- Benzodiazepines may be used to suppress shivering.
- Skin massage is recommended to prevent cutaneous vasoconstriction.

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- Treatment should be continued until the rectal temperature drops to 39°C.
- Antipyretics (aspirin, acetaminophen) have no effect on environmentally induced hypothermia and are contraindicated.
- All patients with suspected heat stroke must be admitted to the hospital for close monitoring.
- Monitoring includes vital signs, temperature and cardiac rhythm and observation for potential complications of electrolyte abnormalities (e.g.hypokalemia), acute kidney injury due to rhabdomyolysis, cardiac arrhythmia, coagulopathy, hepatic failure, acute respiratory distress syndrome (ARDS), hypoglycaemia, seizures and infection.

PROGNOSIS: Multi-organ dysfunction is the usual cause of heat stroke related deaths and it can be predicted by CK >1000 units/L, metabolic acidosis and elevated liver enzymes.Following heat stroke, sensitivity to high environmental temperature may persist for prolonged periods and immediate re-exposure should be avoided.⁹

PREVENTION:

The risk of heat stroke can be reduced by observing precautions to avoid overheating and dehydration. Light, loose-fitting clothes will allow perspiration to evaporate and cool the body. Wide-brimmed hats in light colors help prevent the sun from warming the head and neck. Vents on a hat will help cool the head, as will sweat bands wetted with cool water. Strenuous exercise should be avoided during daylight hours in hot weather; so should remaining in confined spaces (such as automobiles) without air-conditioning or adequate ventilation. In hot weather, people need to drink plenty of cool liquids to replace fluids lost from sweating. Thirst is not a reliable sign that a person needs fluids. A better indicator is the color of urine. A dark yellow colour may indicate dehydration. Thus following aspects must be given due attention.^{10,11}

- (a) Public education programs to improve prevention and early recognition of heat related disorders.
- (b) Proper acclimatization measures must be achieved

before heavy physical exertion is performed in hot environments.

(c) All children’s athletic programs must set heat-acclimatization guidelines.

(d) Parents, coaches, athletic trainers and athletes must be educated about heat related illness, specifically about prevention, risks, signs and symptoms and treatment.

(e) Those who are physically active in a hot environment should increase fluid consumption before, during and after physical activities

(f) Fluid consumption should include balanced electrolyte fluids and water. Drinking fluids must be often, and before one is thirsty¹².

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