

Heat Related Illness: Pathophysiology, Manifestations, Treatment and Prevention

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Abstract

Hot environment and physical exertion during such hot environment such as agricultural work, sports, labor work etc. may lead to adverse health conditions in different forms and severity. These adverse health conditions due to heat is called heat related illness. In this type of illness hematological, cardiovascular, neurological, and renal dysfunctions are associated with high mortality. So, the people at risk to heat related illness need education to understand basic physiology and training about this illness so that people easily recognize the clinical manifestations of heat related illness and save their lives.

The pathophysiology of severe heat related illness such as heat stroke involves failure in thermoregulatory mechanism and cardiovascular overload, resulting in dangerously increasing core body temperature and subsequent multiorgan injury. Immediate cooling remains the most effective treatment strategy. In this viewpoint, I would like to provide an overview of the current literature emphasizing the pathophysiology, clinical manifestations, treatment and prevention of heat related illnesses which might be beneficial to general people and health professionals as well.

Introduction

Heat-related illness occur in hot environment and not necessarily there should present a heat wave¹. Heat-related illnesses comprise a spectrum of syndromes resulting from failure of thermoregulatory mechanisms of human body due to exposure to high environmental heat. Clinical manifestations range from mild skin rash and muscle cramps to life-threatening heat exhaustion and heat stroke.² The severity of temperature and duration of heat exposure directly affects the mortality rate.³ Farmers who work outdoor, Athletes, outdoor laborers, police and army personnel are at greatest risk for heat related illness.^{2,3} In developing countries like Nepal, farmers are particularly vulnerable to heat-related illnesses due to prolonged exposure to high temperatures, direct sunlight, and hard physical works.

An individual thermoregulatory capacity is associated with his/her heart and vessel's ability to meet the metabolic requirements.⁴ So, if the thermoregulatory mechanism fails, the blood flow to the different body organs systems including vital organs is affected and the patient may collapse.

Pathophysiology of Heat Related Illness

Heat Cramps: Slowly developing painful skeletal muscle spasms are called heat cramps. It last for few minutes. Muscle cramps occurs from salt depletion from the body particularly during heavy sweating. In this condition body temperature is normal or slightly elevated. It is treated by giving an oral saline solution and also by stretching cramped muscles and resting in a cool environment.^{4,5}

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Heat Syncope: Heat syncope occurs due to peripheral vasodilatation in hot weather. Its physiological basis is similar to vasovagal syncope. Heat syncope is triggered by a reduction in venous return due to peripheral vasodilatation. It is mediated by the Bezold-Jarisch reflex, producing vagal activation and sympathetic withdrawal, and causing bradycardia, hypotension or both. Initial management involves shifting the person to colder areas, if possible, salt and water supplementation to expand plasma volume. Vagolytic agents or vasoconstrictor might be helpful.^{4,5}

Heat Exhaustion: Heat exhaustion occurs when an individual works in a hot environment for long duration of time and with heavy physical works. The rectal temperature usually is higher than 100°F but less than 104°F. It is manifested by thirst, fatigue, nausea, oliguria, giddiness and finally a state of fainting. Decreased blood volume following heavy sweating and severe peripheral vasodilatations due to heat might lead to fainting. Adequate fluid replacement along with electrolytes and rest in cool environment are the treatment modalities of heat exhaustion.^{4,5}

Heat Stroke: When an individual is exposed to very hot environment for a long duration of time, his/her thermoregulatory mechanisms may fail and can lead to generation of very high body temperature with core body temperature might go above 104°F. This condition is called heat stroke.

If that individual is not treated in time, his/her core body temperature keeps on rising and may lead to fatal conditions manifested by seizures, collapse and unconsciousness. It almost always occurs in association with exposure to hot and humid environments. When body temperature rapidly rises, the person fails to sweat, skin becomes hot and dry and other manifestations start to appear. This is an example of positive feedback mechanism where increase core body temperature increase metabolism and increase metabolism increase body temperature further. This cycle goes over and over again if environmental temperature keeps on going up.^{4,5}

Clinical Manifestations of heat related illness:

Clinical manifestations range from mild to severe symptoms which are mentioned below:

- Heat Rash: Red clusters of small blisters.
- Heat Cramps: Muscle spasms due to loss of salt and water.
- Heat Exhaustion: heavy sweating, weakness, cold, pale and clammy skin, fast and weak pulse which might be associated with nausea or vomiting, and fainting.
- Heat Stroke: A severe condition characterized by a

high body temperature (>103°F), hot, red, dry flushed skin, rapid pulse, and loss of consciousness. Altered mental state or behavior (confusion, agitation, slurred speech)

Treatment of Heat Related Illness

Treatment of heat related illness depends on the degree of severity. Passive cooling and fluid and electrolytes replacement are the treatment of mild cases of heat related illness. But moderate and severe cases should be treated with active intervention like convective cooling with fans and infusion of cold saline. They should be closely observed until the symptoms subside.⁴

Heat stroke is severe life-threatening condition. So, it should be treated urgently with maintaining vital signs such as pulse rate and respiratory rate and airways should be kept intact. Rapid active cooling is also required to lower down the body temperature in such patients. Delay in the treatment might result in fatal outcomes. So, patients should be treated without wasting time. Cold water immersion and ice-water immersion are very effective methods to rapidly lower down the body temperature.⁴

Prevention of Heat Related Illness:

Significant number of people suffer from heat related illness worldwide. People should be prevented from such illness by reducing risk factors. People should be educated or taught to stay in shades or cool spaces with fans. They should be taught to limit their physical activities in hot humid environments. Agricultural workers and labourers should take break frequently while working in hot environments. They should drink a lot of water and fluids.

Public health measures such as heat-wave alerts and heat early-warning systems might also be helpful.^{4,6,7}

Adequate fluid intake is important because it reduces the risk of heat stress and heat related illness. While necessary for safety, protective gear can trap heat and reduce the body's ability to cool down. Workers not acclimatized to hot conditions are at higher risk. So, acclimatization is also help prevent from heat related illness.^{5,6}

The following rules can prevent the people from heat stroke and heat related illness. Stay Hydrated: Drink water every 15 minutes, even if not thirsty. Take Regular Breaks: Rest in shaded or cool areas frequently. Acclimatize Gradually: Slowly increase exposure to hot environments. Wear Appropriate light Clothing: Learn Symptoms and First Aid: Know the signs of heat illness and how to respond. Have an Emergency Plan: Ensure everyone knows what to do in case of a heat-related emergency.^{4,5,6}

Heat related illness including heat stroke is a critical

health issue in the Terai region of Nepal due to its hot and humid climate. Awareness, preventive measures, and prompt medical response are essential to reduce the risk and impact of heat stroke.⁷

The risk of heat related illness is high in certain climates and in particular geographical areas in the countries like Nepal. The risk is much higher in southern plains and low elevated areas such as river valleys. Similarly, such risk is much higher in pre-monsoon and monsoon season.

The adaptation measures are required to minimize the risk of heat related illness. Early warning system for heat wave and awareness programmes to the high-risk people from the community leaders or from government officials might be effective measures to mitigate heat related illness.⁷

Conclusion

Heat-related illnesses are conditions that arise from prolonged exposure to high temperatures along with high humidity and physical exertion. They range from mild form like heat rash or heat cramps to severe form like heat stroke, and the severity of symptoms typically dictates the urgency of medical intervention. Preventing heat-related illnesses among agricultural workers and other outdoor workers requires a comprehensive approach that includes proper training, hydration, work scheduling, clothing, environmental modifications, and emergency preparedness. Understanding the signs and symptoms of heat-related illnesses and taking preventive measures can significantly reduce the risk and severity of these conditions and can save the lives.

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