a network of activated cells and their products. The fruit of such investigations may eventually be medications that effectively reverse the "eosinophilic bronchitis" of asthma with fewer adverse effects.

Mark W Frampton, M.D.
Rochester, New York

Pulmonary and Critical Care Unit, Department of Medicine, University of Rochester School of Medicine and Dentistry.
Reprint requests: Dr. Frampton, 601 Elmwood Avenue, Box 692, Rochester, New York 14642-8692

REFERENCES


Cardiovascular Alterations in Heat Stroke

Heat stroke (HS) constitutes a medical emergency and is associated with a significant mortality. It has been categorized into the "exertional" and "classic" varieties. Exertional HS occurs in generally healthy persons during physical activity in hot, humid climates. It is associated with sweating, central nervous system (CNS) dysfunction, and rectal temperatures of 41°C and higher. Rhabdomyolysis, disseminated intravascular coagulation (DIC), and lactic acidosis are common complications. Classic HS occurs in the older individual, often with intercurrent illness and medication use and after exposure to high ambient temperature for extended periods. Hyperpyrexia, hot dry skin and altered mental status (eg, confusion, stupor, coma) are hallmark features. Rhabdomyolysis, DIC, and lactic acidosis are rarely seen in the classic syndrome.

In this issue of Chest, Dahmesh et al (see page 1210) present right heart catheterization data on ten patients who developed HS during the Hadj pilgrimage in Mecca, Saudi Arabia. As the authors state, the temperatures during the hot summer days in Mecca may reach as high as 50°C, with humidity of 50 percent or higher. About the weather in Mecca it has been said that "the heat is stifling in winter, and almost insupportable, even by Arabs, in summer." Some 1 million to 2.5 million Muslims from all over the world, many in advanced years of life, perform the Hadj every year. This pilgrimage lasts several days, during which time the pilgrims are exposed to the elements. Services include circumambulating the Kaahbah, the house of worship built by Abraham and his son Ishmael, and hastening between the hills of Safa and Marwah, where Hagar, carrying her infant son Ishmael, had wandered the desert in search of water. Because the Islamic calendar is lunar, the year is some 11 days shorter compared to the Gregorian calendar. Thus, the Hadj season may fall during the height of summer for several years in a row, during which time hundreds of pilgrims suffer HS. In the United States, HS is generally considered in association with boot camps, sports (particularly football), and heat waves. This problem came into national focus during the 1990-1991 Persian Gulf crisis.

When exercise or environmental heat stress result in increased body temperature, activation of CNS hypothalamic reflexes results in increased cardiac output, cutaneous vasodilation, increased cutaneous blood flow, and splanchnic vasoconstriction. Thus, efficient heat dissipation requires a functional thermoregulatory center and normally responsive cardiovascular and dermal systems. In individuals acclimated to exercise under conditions of heat, cardiovascular adaptation includes increased plasma volume, increased stroke volume, and decreased heart rate (HR). Heat stroke is caused by excessive body heat storage when high ambient temperature prevents heat dissipation by radiation or convection and sweat evaporation is limited by humidity. Although the fundamental initiating pathophysiology of HS is not fully understood, intense hyperthermia with varying degrees of heat-induced tissue injury, neurohumoral factors, mediator releases, and CNS mechanisms (integrated complex afferent and efferent hypothalamic reflexes involving thermoregulatory, cardiovascular, and pulmonary mechanisms) probably all contribute.

Excluding preexisting coronary or other structural heart disease and the influence of cardio depressant drugs, a central question is whether circulatory shock and collapse in HS are due to myocardial dysfunction, volume depletion, peripheral vascular failure, or a combination of those factors. Are other factors involved? And what molecular and cellular mechanisms and transducing neurohumoral pathways are involved?

Using right heart catheterization, Sprung studied seven elderly individuals with classic HS. All were hypotensive. Two patients had increased cardiac index.
been cardiac included which within degeneration hyperdynamic recruits patients pulmonary ventricular hemodynamic treatment death concentration systemic by elevated (low peripheral) 1989 CI, Zahger whom whom HS right-sided dysfunction.3 The hemodynamic data of Dahmash et al are of interest since few studies in the literature have included data concerning cardiovascular and pulmonary hemodynamic function in early presentations of classic HS. The hyperdynamic circulatory profiles (increased cardiac output, low SVR, and low to normal BP) have been described previously. The normal PCWP and SVR appear to exclude any substantial left or right ventricular systolic (and perhaps diastolic) dysfunction, although the data do not contain information on cardiac chamber size, diastolic volume, and ejection fraction. The suggestion is that in relatively “uncomplicated” forms of classic HS treated expeditiously with cooling before severe tissue damage has occurred (and with no coexisting cardiopulmonary disease, no significant tissue injury or rhabdomyolysis, and no DIC), the hyperdynamic cardiovascular profile is not accompanied by significant abnormalities in pulmonary hemodynamics or in cardiac function. Whether more severe forms of HS mimic much of the pathophysiology of sepsis syndromes, implicating roles for endotoxin12,13 and a complex array of inflammatory immune mediator systems,7 remains to be fully elucidated.

Zakauddin A. Vera, M.D., F.C.C.P.
Carroll E. Cross, M.D., F.C.C.P.
Davis, California

Divisions of Cardiovascular Medicine (Dr. Vera) and Pulmonary and Critical Care Medicine (Dr. Cross), University of California School of Medicine, Davis.
Reprint requests: Dr. Vera, UCD Professional Building, Room 2040, 4301 X Street, Sacramento, California 95817

REFERENCES
1 Austin MC, Berry JW. Observations on one hundred cases of heat stroke. JAMA 1936; 161:1595-59
3 Haneef S. What everyone should know about Islam and Muslims. Des Plaines, IL: Library of Islam, 1985; 51-9
5 Rowell LB. Human cardiovascular adjustments to exercise and thermal stress. Physiol Rev 1974; 54:75-159