

P révention en pratique médicale

Extreme heat

"Doctor, the heat is killing me!"



The health effects of heat waves should not be underestimated. Last summer in Europe, public health authorities assessed that the heat wave that struck in August resulted in about 21 000 deaths. A total of 15 000 of these deaths were registered in France, including 1 154 in the region of Paris. From 4 to 12 August 2003, the maximum temperature in Paris was consistent-

ly above 35°C. During the nights of 11 and 12 August, the mercury remained above 25°C, exacerbating the problem.

The number of deaths increases when the humidex is between 30 and 39. In Toronto, a retrospective study has demonstrated that there are at least an additional 3.5 deaths per day attributable to excessive heat when the humidex level is between 40 and 45.

What are heat waves?

In Canada, the humidex is used to express the combined effect of heat and humidity. A humidex of 30 to 39 is associated with a varying degree of discomfort; if the humidex is 40 or more almost everyone is uncomfortable. Environment Canada issues extreme hot weather warnings when the air temperature reaches 30°C and the humidex is 40. Although there is no official definition of 'heat wave', it is usually considered to be a period of three consecutive days during which the air temperature is over 32°C.

How does hot weather affect our health?

Extreme heat can affect our health in a number of ways and to varying degrees of severity: dehydration, fatigue, cramps, fainting, exhaustion, and heatstroke.

Of greater concern, in terms of the number of people affected, are the premature deaths that occur among people with chronic diseases during periods of extreme heat. In fact, epidemiological studies have shown that most health-related deaths did not present the classic signs of heat-related pathologies.

Heat-related pathologies

Heatstroke

- Type of hyperthermia (core body temperature rises above 41°C) associated with multiple organ dysfunction in which encephalopathy predominates.
- Rapid onset, with delirium or coma; only 20% of patients have prodromal symptoms.
- Medical emergency, 40% case fatality.

Heat exhaustion

- Less serious than heatstroke (body temperature rarely over 38.9°C).
- Causes dizziness, weakness and fatigue, without affecting higher mental functions.
- Results from water and salt depletion in the body, after several days of exposure to heat.

Heat syncope

- Temporary loss of consciousness.
- Results from insufficient flow of blood to the brain.
- Occurs among people engaged in physical activity and elderly people.

Heat cramps

- Momentary, intermittent and often severe muscle cramps.
- Occur during or shortly after exercising.
- Seem to result from temporary electrolyte imbalance.

Characteristics of a dangerous heat wave

- Heat wave that occurs early in the summer before the body is acclimatized to heat. By the end of summer, heat waves present less risk.
- Heat wave that appears suddenly, especially if it follows a period of cool weather, since acclimatization is gradual.
- Heat wave during which hot temperatures persist even at night, offering no relief.
- Heat wave associated with high pollution levels (smog).

Physiological response

To succeed in maintaining a normal body temperature, the thermoregulation mechanism—mainly cutaneous vasodilation and sweating—is controlled by the hypothalamus as core body temperature rises.

By increasing peripheral circulation to the skin, the body exposes a higher volume of blood to thermolysis. Peripheral vasodilation is essential to sweating,

which increases thermolysis through evaporation. When it is hot, evaporation is the main mechanism through which body heat escapes; therefore, it is responsible for 75% of thermolysis. Normal sweat loss is 500 ml/24 hours. Sweat contains about 40 mmol/l of sodium, 7 mmol/l of potassium and 35 mmol/l of chloride. In extreme conditions, up to 1 litre of water can be lost per hour. Anti-diuretic hormone and aldosterone secretion, and increased heart and respiratory rates are some of the mechanisms involved in thermoregulation.

The body adjusts to heat with prolonged exposure. In addition to better tolerance to heat (psychological tolerance), the body also develops physiological tolerance. It occurs after several days (about 1 week) of exposure to high temperatures, and disappears several weeks after exposure ends. An increased ability to sweat (earlier, more abundant, reduced salt concentration) and earlier cutaneous vasodilation in some parts of the body are characteristic of the body adjusting to heat.

THERMOREGULATION MECHANISMS

The body produces heat through metabolic activity. There are four mechanisms through which heat transfers between the body and the environment.

Name	Thermoregulation mechanism	Example
Conduction	Energy transfer from a warmer to a cooler object	Immersing oneself in cool water
Convection	Circulation of air or water vapour around the body	Sitting in front of a fan. Care should be taken, however, when using a fan if no windows are open to let in cool air.
Radiation	Electromagnetic waves (such as solar radiation or a microwave oven)	Significant accumulation of heat when a person is exposed to the sun.
Evaporation	The moisture in sweat (and, secondarily, in the respiratory tract) changes from liquid to gas	Evaporation is maximised in a hot and dry environment, and by the wind.

What are the risk factors?

A hot environment: Living in a place where there is no air conditioning or on the top floor of a building and without access to a cool place during the day is linked with increased mortality during periods of hot weather.

Limited physiological response: Several diseases can limit the body's capacity to tolerate heat stress. Some conditions, such as autonomic nervous system problems associated with diabetes, reduce the effectiveness of thermoregulation. Other diseases may decompensate due to the response to heat. For example, peripheral vasodilation occurs at the expense of cardiac output, which has to double or even quadruple.

Physical activity: Some workers, people in the military and athletes are particularly at risk of heat-related pathologies, despite the fact that they are young and in good health. If a person who is obese or has febrile illness or diarrhea engages in intense physical activity when it is very hot, their risk of suffering from heatstroke increases.

Limited capacity to protect oneself: Frail individuals may have difficulty protecting themselves, drinking regularly, or getting to cooler places. Patients with psychiatric illnesses may adopt inappropriate behaviours during periods of extreme heat.

Why are seniors particularly at risk?

In addition to limitations linked to chronic diseases, loss of autonomy and medications, seniors do not adapt to heat as well other people because of their reduced ability to perceive heat, fibrotic sweat glands, and decreased subcutaneous capillary blood flow.

Patient management

Step 1 • Identify clients at risk

Who is at risk?

- Seniors
- People with chronic diseases
- Infants and very young children
- Homeless people
- People who work in a hot environment

Aggravating factors

- Lack of air conditioning
- Social isolation or loss of autonomy
- Poverty
- Alcohol and drug consumption
- Physical exertion
- Medication

Chronic diseases and pathologies that put patients at risk during hot days

- Cardiovascular: atherosclerosis, uncontrolled hypertension, heart failure, peripheral or cerebral vascular disease
- Neurological: Parkinson's disease, Alzheimer's and related conditions, nervous system abnormalities
- Endocrine: diabetes, hyperthyroidism
- Psychiatric disorders
- Others: respiratory failure, kidney failure, obesity, infections, eating disorders, dehydration, skin lesions, sickle-cell anaemia, cystic fibrosis

Step 2 • Adjust treatments

During a heat wave, you may have to review some of your patients' medications. Heat is not an absolute contraindication in itself. However, as can be seen below, several classes of drugs interact with a person's reaction to heat.

Risks and benefits should therefore be evaluated for each patient. First, it is always important to ensure that patients follow the advice they are given on environment and hydration. Before changing a patient's medication, it is important to evaluate his or her state of hydration (fluid intake, weight, heart rate, blood pressure) and to supplement it, if needed, with a dose of electrolytes and an evaluation of creatinine clearance.

Be cautious with NSAIDs, which are especially nephrotoxic for dehydrated patients, and with acetaminophen in case of fever because it does not treat heatstroke effectively and can aggravate liver damage.

Similarly, it is important to evaluate salt and water intake restrictions prescribed to patients, in light of each individual's state of health.

MEDICATION WARNING

MEDICATIONS THAT COULD AGGRAVATE EXHAUSTION-DEHYDRATION SYNDROME AND HEATSTROKE	
Medications that cause hydration and electrolytic problems	Diuretics, in particular loop diuretics (furosemide)
Medications that can impair the renal function	NSAID (including salicyl > 500 mg/j, classic NSAID and selective COX-2 inhibitors) ACEI Angiotensin II receptor antagonists Sulphonamides Indinavir
Medications with kinetic profiles that can be affected by dehydration	Lithium salt Anti-arrhythmics Digoxin Anti-epileptics Biguanides and sulfa-based hypoglycemics Statins and fibrates
Medications that can prevent caloric loss	
• Centrally	Neuroleptics Serotonergic agonists
• Peripherally	Anticholinergic medications (to decrease sweating) <ul style="list-style-type: none"> - tricyclic antidepressants - first generation antihistamines - some antiparkinsonians - some antispasmodics, in particular those for the urinary tract - neuroleptics - disopyramide - pizotifen Vasoconstrictors <ul style="list-style-type: none"> - sympathomimetic agonists and amines - some anti-migraine drugs (rye ergot derivatives, triptans) Medications that reduce the heart rate <ul style="list-style-type: none"> - beta-blockers - diuretics
• Through changes to the basal metabolism	Thyroid hormones
HYPERTHERMIC MEDICATIONS (under normal temperatures or in case of heat waves)	
	Neuroleptics Serotonergic agonists
MEDICATIONS THAT CAN AGGRAVATE THE EFFECTS OF HOT WEATHER	
Medication that can lower blood pressure	All antihypertensives Antianginals
Medications that can affect alertness	

Source: Ministère de la Santé et de la Protection sociale et ministère délégué aux Personnes âgées, *Plan National Canicule, Annexe 7 : Recommandations en cas de fortes chaleurs, fiche 4.4 Médicaments et chaleur*, p.149, mai 2004 • www.sante.gouv.fr (click on canicule and chaleurs extrêmes)

Step 3 • Counsel your patients

Simple measures can help the body better tolerate heat. It is important that your patients be aware of what to do when it is hot.

- Avoid the heat by staying in an air-conditioned environment. People who do not have access to air conditioning at home should go to the swimming pool or to air-conditioned places such as shopping centres, movie theatres and community buildings as often as possible. Resting a few hours a day in an air-conditioned place is an effective way of reducing mortality and morbidity linked to extreme heat.
- Windows should be kept shut as long as the indoor temperature is cooler than it is outdoors. Therefore, windows should be opened, especially at night, if the home is not air conditioned. Be aware that a patient may not want to keep the windows open for fear of intruders.
- Care should be taken when using fans: they can only bring relief if an open window lets in cooler air. Moreover, they have not been shown to be effective in reducing heat-related morbidity and mortality.

- Close the curtains and shutters on windows facing the sun.
- Increase fluid intake: drink more than usual and avoid alcohol. It is important to drink before becoming thirsty because once thirst is noticed, a 70 kg individual has already lost about 1 liter of fluids. It is also important to eat foods to replace the salt that has been lost. It may be more appealing to drink liquids if they are fresh and lightly sweetened; however, care should be taken with commercially-prepared drinks, which often contain too much sugar.
- Wear light, loose-fitting and lightly coloured clothes.
- Take cool showers or baths as often as necessary.
- Reduce physical activity to a minimum and postpone outdoor activities until the day cools off.
- Do not leave children unattended in enclosed areas such as cars.
- Make sure a friend or family member or someone from a community resource can contact your patient during a heat wave to ensure that their health is fine.

Give your patients a copy of the flyer “Hot days are a health risk”. If you would like more copies, please contact Maryse Arpin at (514) 528-2400, extension 3257. A flyer entitled “Attention au coup de chaleur” was especially designed for workers and is available from the CSST (in French only, at www.csst.qc.ca)

Conclusion

Physicians, in cooperation with public health professionals, can prevent health problems and deaths due to hot weather. Through interventions and sensible advice about what to do during heat waves, they can reinforce and personalise messages broadcast to the population. In case of a severe heat wave, the Montréal Public Health Department, municipal authorities, and the Emergency Preparedness Centre will deploy an emergency plan, in which physicians will be asked to participate.

Prévention en pratique médicale

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Heat waves

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