
Near-drowning and hypothermia

The term near-drowning is applied to a submersion victim who is taken to an emergency facility and survives 24 hours.¹ The quality of survival is not mentioned, but permanent brain damage is common owing to the brain's vulnerability to asphyxia.

In Canada, water temperatures may range from 15°C to less than 5°C throughout most of the year. When a child falls into very cold water but does not remain totally submerged, the body temperature decreases within 5 to 20 minutes to levels of moderate hypothermia (34° to 28°C or less). This cooling, termed immersion hypothermia, may cause death by several mechanisms, but, paradoxically, it protects the brain from hypoxia. If rescue occurs within 10 to 30 minutes complete recovery is possible.

The term submersion hypothermia is applied when immersion hypothermia is complicated by submersion and asphyxia. Although cooling and drowning may occur separately, simultaneously or sequentially, each process is distinct and requires different treatment.

It is well known that when an inadequately clothed person suffers prolonged exposure to cold, accidental hypothermia may develop.² Immersion hypothermia is an accelerated version of the same process. No amount of shivering or exercise can compensate for the great heat loss that occurs when one is immersed in icy water. The cooling process is more rapid in vigorous swimmers owing to skeletal muscle vasodilatation and the consequent accelerated

heat loss from the extremities. Children are even more vulnerable because of their larger surface area relative to body volume and their lack of insulating fat. The temperature of the water is crucial, for the rapidity of cooling and death are directly related. A water temperature below 12°C causes paralysis of precapillary sphincters, which allows unimpeded blood flow through the cutaneous capillaries.³ When the temperature of the water is 0°C death usually occurs within 1 hour, whereas when it is 15°C death usually occurs within 6 hours. However, when the temperature is 20°C or higher almost all persons survive.⁴

If a person is properly supported by a life-jacket the head remains above the surface of the water; therefore asphyxia will not occur. Brain damage will only develop after cardiorespiratory failure.

Several mechanisms leading to cardiac arrest may cause death from immersion hypothermia. The usual course of events is a relentless reduction of core temperature, with delirium when it is 35°C, unconsciousness when 32°C and spontaneous ventricular fibrillation when less than 28°C.⁵ It is important to appreciate that in this situation cooling precedes the development of bradycardia and subsequent cardiac arrest. The sequence is similar to that of elective hypothermia for cardiovascular operations, and it is therefore not too surprising that a person can make a complete neurologic recovery after much longer periods of immersion and cardiac arrest

than previously thought possible.

Death from immersion hypothermia may also occur as a result of two less common mechanisms associated with a poorer prognosis. Rarely the sudden shock of entering ice-cold water causes immediate ventricular fibrillation (the immersion syndrome⁶) before preliminary cooling has occurred. More frequently, unconsciousness from cooling leads to cessation of swimming and subsequent drowning, or, if the person is properly supported, cooling continues until cardiorespiratory arrest occurs (usually at a core temperature of 25°C). Obviously, core temperature and duration of bradycardia or cardiac arrest are crucial factors that affect potential recovery, but the exact limits are unknown. Therefore, treatment must be instituted in all cases, and resuscitation must be continued, regardless of the time required, until the body temperature reaches at least 30°C and cerebral death is obvious.

When rescued, all these persons appear to be dead, but if cardiorespiratory arrest has not occurred the chances of complete recovery are excellent if proper treatment is given. Oxygen should be administered by mask, and warm blankets should be applied. The patient should be handled gently so that ventricular fibrillation is not triggered during transportation of the patient to hospital. If it is unknown whether cardiac arrest has occurred, closed-chest massage and artificial respiration should be started immediately. These two measures must be continued

without pause during rapid transport to the nearest hospital.

In the emergency department the following measures should be undertaken without delay and in the following order:

- A nasotracheal tube should be inserted for ventilation with 100% oxygen while cardiac massage is continued.

- A blood-pressure cuff and electrocardiogram leads should be applied to monitor the circulation, and defibrillation should be performed if necessary.

- A large-bore intravenous cannula should be inserted to withdraw blood for laboratory studies such as hemolysis tests, crossmatch and typing, culture, and determination of the hematocrit and concentrations of serum electrolytes, blood urea nitrogen and hemoglobin. Volume expanders (plasma, Ringer's solution or dextran) should also be administered.

- After an arterial blood sample is taken for blood-gas determinations, up to 50 mL (the dose for adults) of sodium bicarbonate should be given intravenously to counteract the severe metabolic acidosis of hypothermia and to facilitate the action of inotropic drugs if they are required.

- A rectal thermometer and a urethral catheter should be inserted.

- When the circulation has been satisfactorily re-established an arterial line should be inserted for serial blood-gas measurements and continuous monitoring of blood pressure.

- A central venous catheter may be considered for blood volume management, but stimulation of the right atrium by the catheter tip may trigger atrial fibrillation.

- A chest roentgenogram and examination for head injuries must be included as part of the initial routine management of these cases.

Rewarming the patient to correct the total metabolic effects of immersion hypothermia is an urgent need. However, if the patient has suffered prolonged cardiac arrest or submersion, the effects on the brain of rapid rewarming may be disastrous. In this situation, treatment should follow the guidelines suggested for the treatment

of submersion hypothermia outlined below. Core temperatures as low as 30° to 31°C are amenable to either treatment regimen, and are consistent with full recovery. The best method of warming patients with immersion hypothermia remains controversial, but it is determined by whatever means are available.

A hot bath (water temperature of approximately 40°C) is simple and always available. Unfortunately, warming by such means is slow and causes an "after-drop" of temperature, creates large temperature gradients predisposing to ventricular fibrillation under circumstances that make defibrillation risky, and requires the patient to be in the unsatisfactory head-up position. The use of peritoneal dialysis with warm Ringer's solution (at a temperature of 40°C) is simple, effective and available, and it produces more rapid core rewarming. Other methods, such as perfusion of warm fluids per rectum, by gastric lavage or by thoracotomy, have been described.^{3,7-9}

The use of heated vapours is controversial owing to the low specific heat of gases. The use of extracorporeal warming is ideal but seldom available.

The term submersion hypothermia is applied when cooling follows acute asphyxia. The risk of brain damage is consequently much greater and the maximum submersion time consistent with full recovery is correspondingly shorter. Nevertheless, the cooling process in children is rapid and may be greatly benefitted by the "diving reflex",¹⁰ the circulatory reflex triggered neurologically by apnea and immersion of the face that shunts blood and available oxygen to the heart and brain and is accompanied by bradycardia, thus permitting prolonged submersion. This reflex is particularly active in children when they are submerged in very cold water.

Numerous instances have been reported of children surviving submersion in cold water for as long as 10 to 40 minutes.¹¹⁻¹⁴

At the time of rescue and transportation to hospital, patients with submersion hypothermia should be

treated as outlined previously, except that no rewarming efforts should be initiated unless the core temperature is less than 30°C. Body temperature should be maintained at 30°C to facilitate recovery of brain function.

Following resuscitation and stabilization of the circulation, comatose patients should be aggressively treated in a critical care unit to preserve brain function and forestall an increase in intracranial pressure. The details of this management¹⁵ can be summarized as follows: Dehydration is induced by diuretics and limited administration of fluids. Ventilation is controlled by the use of inspired oxygen concentrations of more than 70%, and the carbon dioxide pressure of arterial blood is maintained at 30 mm Hg. To reduce cerebral oxygen requirements, the temperature is maintained at 29° to 31°C and large doses of barbiturates (e.g., 3 mg/kg of pentobarbital administered intravenously once every hour) are used. Dexamethasone sodium phosphate (1.0 mg/kg daily in four doses), relaxants (e.g., pancuronium bromide, 1 mg/kg administered intravenously), chlorpromazine (5 to 25 mg administered intramuscularly) and other drugs are used as needed. This therapy requires intensive monitoring, including continuous direct measurement of intracranial pressure. For treatment to be successful it must be started within 1 to 2 hours and be maintained for at least 48 to 72 hours. At the Hospital for Sick Children in Toronto this regimen reduced the frequency of permanent brain damage from 30% in 30 patients from 1970 through 1974 to 7.7% in 26 patients from 1975 through 1977.¹⁶

It is essential that all submersion victims, even when they are conscious and alert, be admitted for 24 hours of observation and investigation. Approximately 15% of near-drowning victims who are conscious at the time of admission die of "delayed" drowning from pulmonary and cerebral causes.¹¹ A recommendation that all unconscious patients, whether hypothermic or normothermic, should receive full "cerebral salvage" treatment appears to be

justified. Complications such as aspiration, hemolysis and renal failure can be treated successfully with recognized methods; however, they are of secondary importance.

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sinemet*

(levodopa and carbidopa combination)

INDICATIONS

Treatment of Parkinson's syndrome with exception of drug induced parkinsonism.

CONTRAINDICATIONS

When a sympathomimetic amine is contraindicated; with monoamine oxidase inhibitors, which should be discontinued two weeks prior to starting SINEMET*; in uncompensated cardiovascular, endocrine, hematologic, hepatic, pulmonary or renal disease; in narrow-angle glaucoma; in patients with suspicious, undiagnosed skin lesions or a history of melanoma.

WARNINGS

When given to patients receiving levodopa alone, discontinue levodopa at least 12 hours before initiating SINEMET* at a dosage that provides approximately 20% of previous levodopa.

Not recommended in drug-induced extrapyramidal reactions; contraindicated in management of intention tremor and Huntington's chorea.

Levodopa related central effects such as involuntary movements may occur at lower dosages and sooner, and the 'on and off' phenomenon may appear earlier with combination therapy.

Monitor carefully all patients for the development of mental changes, depression with suicidal tendencies, or other serious antisocial behaviour.

Cardiac function should be monitored continuously during period of initial dosage adjustment in patients with arrhythmias.

Upper gastrointestinal hemorrhage is possible in patients with history of peptic ulcer.

Safety of SINEMET* in patients under 18 years of age not established.

Pregnancy and lactation: In women of child-bearing potential, weigh benefits against risks. Should not be given to nursing mothers. Effects on human pregnancy and lactation unknown.

PRECAUTIONS

General: Periodic evaluations of hepatic, hematopoietic, cardiovascular and renal function recommended in extended therapy. Treat patients with history of convulsions cautiously. **Physical Activity:** Advise patients improved on SINEMET* to increase physical activities gradually, with caution consistent with other medical considerations. **In Glaucoma:** May be given cautiously to patients with wide angle glaucoma, provided intraocular pressure is well controlled and can be carefully monitored during therapy. **With Antihypertensive Therapy:** As symptomatic postural hypotension has been reported occasionally, give cautiously to patients on antihypertensive drugs, checking carefully for changes in pulse rate and blood pressure. Dosage adjustment of antihypertensive drug may be required. **With Psychoactive Drugs:** If concomitant administration is necessary, administer psychoactive drugs with great caution and observe patients for unusual adverse reactions. **With Anesthetics:** Discontinue SINEMET* the night before general anesthesia and reinstitute as soon as patient can take medication orally.

ADVERSE REACTIONS

Most Common: Abnormal Involuntary Movements—usually diminished by dosage reduction—choreiform, dystonic and other involuntary movements. Muscle twitching and blepharospasm may be early signs of excessive dosage. **Other Serious Reactions:** Oscillations in performance: diurnal variations, independent oscillations in akinesia with stereotyped dyskinesias, sudden akinetic crises related to dyskinesias, akinesia paradoxa (hypotonic freezing) and 'on and off' phenomenon. **Psychiatric:** paranoid ideation, psychotic episodes, depression with or without development of suicidal tendencies and dementia. Levodopa may produce hypomania when given regularly to bipolar depressed patients. Rarely convulsions (causal relationship not established). Cardiac irregularities and/or palpitations, orthostatic hypotensive episodes, anorexia, nausea, vomiting and dizziness.

Other adverse reactions that may occur:

Psychiatric: increased libido with serious antisocial behaviour, euphoria, lethargy, sedation, stimulation, fatigue and malaise, confusion, insomnia, nightmares, hallucinations and delusions, agitation and anxiety. **Neurologic:** ataxia, faintness, impairment of gait, headache, increased hand tremor, akinetic episodes, "akinesia paradoxa", increase in the frequency and duration of the oscillations in performance, torticollis, trismus, tightness of the mouth, lips or tongue, oculogyric crisis, weakness, numbness, bruxism, priapism. **Gastrointestinal:** constipation, diarrhea, epigastric and abdominal distress and pain, flatulence; eructation, hiccups, sialorrhea; difficulty in swallowing, bitter taste, dry mouth; duodenal ulcer; gastrointestinal bleeding; burning sensation of the tongue. **Cardiovascular:** arrhythmias, hypotension, non-specific ECG changes, flushing, phlebitis. **Hematologic:** hemolytic anemia, leukopenia, agranulocytosis. **Dermatologic:** sweating, edema, hair loss, pallor, rash, bad odor, dark sweat. **Musculoskeletal:** low back pain, muscle spasm and twitching, musculoskeletal pain. **Respiratory:** feeling of pressure in the chest, cough, hoarseness, bizarre breathing pattern, postnasal drip, **Urogenital:** urinary frequency, retention, incontinence, hematuria, dark urine, nocturia, and one report of interstitial nephritis. **Special Senses:** blurred vision, diplopia, dilated pupils, activation of latent Horner's syndrome. **Miscellaneous:** hot flashes, weight gain or loss. Abnormalities in laboratory tests reported with levodopa alone, which may occur with SINEMET*: Elevations of blood urea nitrogen, SGOT, SGPT, LDH, bilirubin, alkaline phosphatase or protein bound iodine. Occasional reduction in WBC, hemoglobin and hematocrit. Elevations of uric acid with colorimetric method. Positive Coombs tests reported both with SINEMET* and with levodopa alone, but hemolytic anemia extremely rare.

DOSAGE SUMMARY

In order to reduce the incidence of adverse reactions and achieve maximal benefit, therapy with SINEMET* must be individualized and drug administration continuously matched to the needs and tolerance of the patient. Combined therapy with SINEMET* has a narrower therapeutic range than with levodopa alone because of its greater milligram potency. Therefore, titration and adjustment of dosage should be made in small steps and recommended dosage ranges not be exceeded. Appearance of involuntary movements should be regarded as a sign of levodopa toxicity and an indication of overdosage, requiring dose reduction. Treatment should, therefore, aim at maximal benefit without dyskinesias.

Therapy in Patients not receiving Levodopa:

Initially ½ tablet once or twice a day, increase by ½ tablet every three days if desirable. An optimum dose of 3 to 5 tablets a day divided into 4 to 6 doses.

Therapy in Patients receiving Levodopa:

Discontinue levodopa for at least 12 hours, then give approximately 20% of the previous levodopa dose in 4 to 6 divided doses.

FOR COMPLETE PRESCRIBING INFORMATION, PARTICULARLY DETAILS OF DOSAGE AND ADMINISTRATION, PLEASE CONSULT PRODUCT MONOGRAPH WHICH IS AVAILABLE ON REQUEST.

HOW SUPPLIED

Ca8804—Tablets SINEMET* 250, dapple-blue, oval, biconvex, scored, compressed tablets coded MSD 654, each containing 25 mg of carbidopa and 250 mg of levodopa. Available in bottles of 100 and 500.

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