

Injury patterns in Hypothermia induced disorientation---Three case reports.

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We report on 3 cases of severe hypothermia survived by the patient without permanent injury—though some prolonged hospitalization was required in some cases.

Definition

Hypothermia is defined as a drop in the body's core temperature below 35°C (95°F)[Danzl:2002]. The severity of hypothermia is divided into 3 groups: mild 35°C – 32°C (95°F – 90°F), moderate 32°C – 28°C (90°F – 82.4°F), and severe <28°C (<82.4°F). Statistical data on the survival of hypothermia has to be carefully scrutinized for missing body core temperature measurements or mix-up of peripheral temperature with the core temperature [Danzl:2002, Trubner:2000].

The metabolic rate is increased to 40-60kcal/h (170-250kJ/h)—in isolated cases up to 300kcal/h (1260kJ/h)—by an increase in muscle tone during the first cooling period. This metabolic warming process stops below a body core temperature of 30°C (86°F) with a consecutive acceleration of the hypothermia. The patients are responsive to verbal address down to a body core temperature of 32°C (90°F), though they have a retrograde amnesia for that time [Hensel:1985]. Below 32°C (90°F) cardiac output is reduced and atrial arrhythmias are wide spread [Danzl:2002]. There is a greatly increased risk of a metabolic acidosis due to cold diuresis below a body core temperature of 25°C (77°F) [Danzl:2002]. Further complications are a respiratoric acidosis due to respiratory insufficiency [Paton:1985] as well as ventricular arrhythmias and asystoles [Thauer:1962].

Much lower temperatures can be survived when the respiratory insufficiency is treated (e.g. with artificial breathing) and the cardiac arrhythmias are controlled (e.g. using a pacemaker or even better an ICD): During experimental surgery procedures on humans down to 10°C (50°F) [Hensel:1985], on animals down to 0°C (32°F) [Popovic:1974].

In cases of extrem hypothermia the coma can be combined with an isoelectric EEG: This is not a necessarily a sign of brain death but can be reversible [Danzl:2002]!

Case 1:

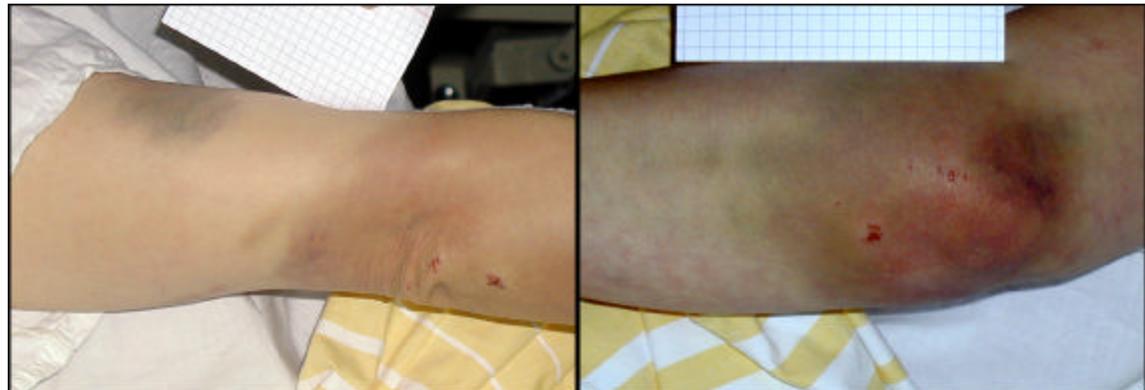
A 38 year old woman took a taxi ride home from a christmas party at around 02:30h in the morning. She instructed the taxi driver to stop 500m away from her flat, got out of the taxi and staggered towards her apartment.

She was found lying on the pavement by a paper-boy at about 06:00h. She was dressed only with socks, panties, and a polo-neck sweater. The remaining cloth were later found underneath a parked car directly in front of her flat. A bloodstain 5cm (2inch) in diameter was found on the pavement as well as some smeared bloodstains on a solitary cigarette vending machine.

The rectal temperature was 32.7°C (90.9°F). On admission to hospital at 06:30h. The blood alcohol level was 0.19%; the blood clothing parameters were shifted towards haemorrhagia. A gynaecological examination revealed no pathological findings, especially no signs of haemorrhages or other injuries.

Epidural as well as subarachnoidal haemorrhages without any osseous injuries were diagnosed by cranial CT. Superficial abrasions were found on the ridge of the nose and to a lesser degree on the forehead. Furthermore haematomas were found around the eyes, transmural through the right cheek and the tip of the tongue.

Gray/blue haematomas were found on the front of the right upper arm as well as on both elbows in combination with superficial abrasions. A solitary blue/purple haematoma was found on the left elbow.



Extensive blue/purple haematomas were found on the outside of both thighs extending towards the buttocks. The only injury with definite shape was located in the transition zone from left thigh towards the buttock. It was a faded region of 2.5cm (1inch) in diameter with a central C-shaped graze. Multiple superficial parallel skin rashes were found on the back left of the sacrum.



Extensive areas of grey/yellow skin discolorations were located above both knees. Extensive areas displaying a yellow/red discoloration, liquid filled blisters were found in front and below both knees. Red discoloration with central necrosis was located on the back of all toes. Substantial tissue defects down to the subcutis were located in the region of the main big toe joint. These defects were already surgically attended to at the time of examination.



The results of the examination are summarized in table 1.

Case 2:

A 78 year old inpatient was found in the bushes next to her old peoples home one winter morning. She was lying on her right side. She was just dressed with a pair of trousers and a nightgown.

Due to blood staining on the outside doors of the old peoples home the police suspected a crime of violence.

On admission the body core temperatur was 32.0°C (89.6°F)

Superficial abrasions were located above the malar bone. Skin of vellum consistency with haematomas on the rear sides of both forearms extending from the elbow to hand.

Multiple superficial skin abrasions with scab were located on the right elbow, the joints of the fingers of the right hand, and the joint of the left thumb. Furthermore skin abrasions were found in front of the right shin bone, both insteps and all toes.



Red/brown discolorations as morphological signs of frostbite were located above the right shoulder extending towards the outside of the upper arm, the right breast, and extensively in the area of both knees.

The scratches on the exposed skin were seen as a result of recurrent falls to the ground. A summary of the results is given in table 1.



Case 3

A 75 year old dentist worked in his unheated garage one autumn morning. At about noon he fell off his chair and laid unconscious on the concrete floor. (The injury pattern can be found in table 1.)

On arrival of the emergency services an instable tachyarrhythmia as well as other ECG abnormalities were diagnosed. Only after 12 defibrillations was the patient stabilised and could be flown to the University hospital by helicopter. The crew forgot to cover the patient with the mandatory electric blanket. Just after 15:00h the patient was admitted to the emergency room. The patient was comatose, the body core temperature was measured to 31.7°C (89.1°F) using a bladder catheter.

A solitary blue/violet haematoma, 4cm (1.6inch) in diameter was found on the outside of the left upper arm. A myocardial infarction was diagnosed. The hypothermia was treated using a symptomatic therapy. The patient was alert after 3 days. At this time residues of the myocardial infarction were not detectable in either ECG or echocardiography. The patient had normal heart rate, an ICD (Implantable Cardioverter/Defibrillator) was implanted. It is the conviction of the authors as well as the treating physicians that the minimal myocardial damage was due to the hypothermia.

	Rashes and Bleedings			Frostbite		
	Case 1	Case 2	Case 3	Case 1	Case 2	Case 3
Forehead	+	-	-	-	-	-
Eyelids	++	+	-	-	-	-
Malar bone	+	+	-	-	-	-
Nose	++	-	-	-	-	-
Cheek	++	-	-	-	-	-
Chin	-	-	-	-	-	-
Neck	++	-	-	-	-	-
Shoulder	-	-	-	-	++	-
Upper arm	-	++	+	-	+	+
Elbow	++	+	-	+	+	-
Forearm	+	++	-	-	-	-
Hand/Finger	++	++	-	+	+	-
Back	+	-	-	-	-	-
Pelvis	++	-	-	-	-	-
Thigh	++	-	-	-	-	-
Knee	-	-	-	++	++	-
Lower leg	-	+	-	-	+	-
Feet/Toes	+	+	-	++	++	-

Table 1

Localisation and severity of rashes, bleedings, and frostbite. (++ severe, + moderate, - none)

Conclusion

The morphology of the injuries due to the state of hypothermia can vary widely, as detailed in the 3 case reports. These injuries can not only lead to a maldiagnosis of crimes of violence in the dead [Trubner:2000], but also in the living.

In relation to Samuel Shem's rules of the 'House of God': 'In order to diagnose a fever you have to measure the temperature'[Shem:1978], one has to postulate that in order to diagnose hypothermia the body core temperature has to be measured. The diagnosis of hypothermia is clearly not as important to the well being of the patient as the prevention of a misdiagnosis of death. In two of the three cases the patients were proclaimed dead by the paramedics---in both cases a full recovery, a restitutio ad integrum, was achieved.

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