HYPOTHERMIA OCCURS when the body’s temperature falls too low. It is widely accepted that this is when body temperature falls to 35˚C or below (Pedley et al 2002). Hypothermia can be classified as mild, moderate, severe or profound. Black and Hawks (2005) identify mild hypothermia as a body temperature of 34-35˚C, moderate 30-34˚C, and severe as a body temperature below 30˚C. However, Brooker and Nicol (2003) suggest slightly different ranges of temperature for mild, moderate and severe hypothermia and they also include a fourth stage of profound hypothermia. They identify mild hypothermia as being 32-35˚C, moderate as 28-31.9˚C, severe as 20-27˚C, and profound as below 20˚C.

Thermoregulation

Body temperature is monitored and regulated by temperature-regulating centres in the hypothalamus. Information about core body temperature and that on the surface of the body is supplied to the hypothalamus by thermoreceptors. The hypothalamus reacts to this information by initiating a number of responses. When temperature rises the body responds by making attempts to bring the temperature back to within normal limits. These responses are examples of negative feedback systems, where the body’s response is opposite to that of the stimulus. For example, when the body is becoming too warm (stimulus), the response is to bring about measures to counteract this and thereby bring body temperature back within normal parameters. When the body is too hot, cooling is achieved by increasing the flow of blood to the skin where heat is then removed from the body by radiation. Sweat glands are also stimulated and the release of sweat from these glands assists in this cooling process by evaporation. In addition, heat is lost through the skin by the processes of conduction and convection (Tortora and Derrickson 2006). Simple procedures, such as removing outer layers of clothes, will promote heat loss from the body and ingestion of cold drinks will also aid cooling.

When the body’s temperature begins to fall below normal limits, the thermoreceptors relay this information back to the hypothalamus, which responds by stimulating several body effectors (Figure 1). When activated, these work together to bring the body’s temperature back to within normal limits. These responses include reducing heat loss from the skin by vasoconstriction, which reduces the flow of warm blood from the core to the extremity. This helps to maintain blood flow to the internal organs, thereby helping to protect core body temperature. Piloerection also occurs, where the hairs on the skin stand erect, trapping air between them which is then warmed and acts as an insulator (Neno 2005). Skeletal muscle tone increases and shivering generates much heat where body heat production can rise to about four times the normal rate in a few minutes (Tortora and Derrickson 2006).

The hormones adrenaline (epinephrine), noradrenaline (norepinephrine) and thyroxine all increase cellular metabolism, which helps to generate body heat (Cuddy 2004). Increasing the layers of clothes worn, wearing a hat and ingesting warm liquids and foods all help to prevent heat loss and maintain body temperature. A total of 60% of body heat can be lost through the top of the head (Cooper 2006), so head covering is important when body temperature begins to fall.

Summary

This article describes the signs and symptoms of hypothermia and outlines its acute nursing management.

Authors

Alistair Farley is lecturer in nursing and Elia McLafferty is senior lecturer, University of Dundee, Dundee. Email: a.h.farley@dundee.ac.uk

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NURSING STANDARD

Nursing management of the patient with hypothermia

Older adults are particularly prone to hypothermia as they respond slowly to changes in environmental temperature. This is as a result of various physiological changes associated with ageing. These include a decreased shivering response to cold, a decrease in metabolic rate, a slowing down of vasoconstriction typically associated with cold environmental temperatures and a reduction in the perception of cold (Brooker and Nicol 2003). A number of straightforward measures can reduce the risk of hypothermia in older adults (Box 1).

**Hypothermia**

Hypothermia occurs when there is excessive heat loss from the body, when the body is unable to continue to respond to heat loss or when the temperature regulatory centre in the hypothalamus malfunctions (Ramont and Niedringhaus 2004). Environmental conditions, such as windy and wet weather, can accelerate the onset of hypothermia (Rosdahl and Kowalski 2003). A common cause of hypothermia in older adults is as a result of a prolonged period lying on the floor after a fall. This is because of a combination of changes due to the ageing process, decreased levels of mobility and a cool or cold ambient temperature. A rapid response to falls in older adults will, therefore, reduce the risk of patient hypothermia.

The development of hypothermia is usually unintentional or accidental (Black and Hawks 2005). However, there are instances of induced hypothermia where the body temperature is deliberately lowered to make surgery safer (Rosdahl and Kowalski 2003), such as in cardiac and brain surgery (Ramont and Niedringhaus 2004).

**Symptoms** The symptoms of hypothermia are numerous and varied (Box 2).

**Acute management of hypothermia**

The aim of treatment is to regain an oral temperature of 37°C (Thompson et al 2002). The patient’s temperature, pulse, blood pressure and respiratory rate should all be monitored every half hour during the initial phase of management. On evidence of temperature improvement vital signs should continue to be monitored every one to two hours until body temperature reaches 35°C (Brooker and Nicol 2003). Core temperature should be recorded using a tympanic or rectal thermometer (Elliot and Kiran 2006), although the tympanic membrane temperature is becoming the preferred option for recording core temperature. Nurses should be aware that the readings from the tympanic membrane are slightly higher than oral temperature readings (Ramont and Niedringhaus 2004).

The first consideration should be airway management. Staff should, therefore, ensure the patient has a patent airway. Oxygen can be administered to correct hypoxia which, if not rectified, can lead to inadequate cerebral perfusion (Brooker and Nicol 2003). Where possible the oxygen should be warmed and humidified (Elliot and Kiran 2006). This prevents further cooling of the body and keeps the airways moist.

Fluid administration may be required to correct dehydration, therefore, intravenous (IV) access should be established. Fluids should also be warmed before being administered to prevent further cooling of the body. Some authors suggest that inserting a central venous catheter (CVC) is useful to monitor fluid replacement and to prevent the possible complication of fluid overload. However, Lloyd (2006) states that inserting a CVC...
is not without its dangers because of the risk of triggering ventricular fibrillation if the endocardium is touched during this procedure.

Inserting an indwelling urinary catheter is advisable to monitor urinary output closely, as the patient may be at risk of hypovolaemia. Fluid loss is associated with a cold diuresis (increased urine production on exposure to cold), which is linked to fluid movement from the peripheries to the core, creating a relatively hypervolaemic core state. This results in a decreased release of antidiuretic hormone (ADH) (Brooker and Nicol 2003). The resultant decrease in ADH leads to an increase in urinary output which, in turn, leads to excessive fluid loss and hypovolaemia.

Blood glucose levels should be measured immediately as hyperglycaemia is common once body temperature falls to 30˚C. Hypothermia inhibits insulin release from the pancreas and also increases the cells’ resistance to insulin. As a consequence of reduced insulin release and the cells’ resistance to the insulin present, blood glucose levels will rise adding to the risk of hyperglycaemia (Brooker and Nicol 2003).

An electrocardiogram (ECG) should be recorded as bradycardia and unusual QRS and T complexes are common in patients with hypothermia (Brooker and Nicol 2003). Dysrhythmias may be evident in hypothermic patients, as cold disrupts the conduction system of the heart (Nettina 2006). It is, therefore, necessary to monitor the heart’s electrical activity.

Patients with hypothermia are also at risk of atrial and ventricular fibrillation (Black and Hawks 2005, Cooper 2006). If the patient has severe hypothermia, he or she should be moved carefully as sudden and violent movements can induce cardiac dysrhythmias or arrest (Rosdahl and Hawks 2005). The resultant decrease in ADH leads to an increased release of antidiuretic hormone (ADH) (Brooker and Nicol 2003). IV fluids can be warmed using a blood warmer before infusion (Black and Hawks 2005). Warm air blankets can be used to raise body temperature to within normal limits (Williams et al 2005). These blankets allow warm air to be circulated around the patient’s body, thereby wrapping him or her in a blanket of warm air. Heated pads or blankets can be used to raise body temperature (Holtzclaw 2004) and radiant warmers are another option to raise body temperature to within normal limits (Black and Hawks 2005). The radiant warmers are positioned 70cm above the patient (Williams et al 2005) and heat is directed towards him or her.

Rewarming techniques

During acute management the patient must also be rewarmed and the way this is done depends on the degree of hypothermia (Nettina 2006).

Passive rewarming These measures will be of particular use for patients who have mild hypothermia. Cold or wet clothes should be removed and replaced with warmed clothes and the person covered with prewarmed blankets. If wet, the patient should be gently dried. A head covering should be provided because much heat will be lost from this area if it is left uncovered. If the patient’s condition allows, warming drinks can be supplied to aid with increasing body temperature. Skin should be patted as opposed to being rubbed vigorously as rubbing can send cold blood from the extremities to the person’s core, further reducing core temperature (Worfolk 1997). Single use, disposable laminate blankets should be heated and humidified (Rosdahl and Hawks 2005). The temperature of such fluids should be 42–44˚C (Elliot and Kiran 2006). If oxygen is required it should be heated and humidified (Rosdahl and Hawks 2005).

Active rewarming These measures are best used for patients with moderate to severe hypothermia. If they are able, the patient can be immersed in a warm bath at 40˚C (Black and Hawks 2005). The radiant warmers are positioned 70cm above the patient (Williams et al 2005) and heat is directed towards him or her.

Active core rewarming These measures can be used to reduce the length of time a patient’s temperature is below 32˚C and the aim is to reduce the risk of cardiac arrest (Brooker and Nicol 2003). IV fluids can be warmed using a blood warmer before infusion (Black and Hawks 2005). The temperature of such fluids should be 42–44˚C (Elliot and Kiran 2006). If oxygen is required it should be heated and humidified (Rosdahl and Hawks 2005).

BOX 2

Signs and symptoms of hypothermia

<table>
<thead>
<tr>
<th>Grade</th>
<th>Signs and symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mild hypothermia (32-35˚C)</td>
<td>Cold skin and pallor.  &lt;br&gt; Might not complain of cold.  &lt;br&gt; Slurred speech.  &lt;br&gt; Intense shivering.  &lt;br&gt; Unco-ordination, slow gait, may stumble and fall.  &lt;br&gt; Confusion and/or disorientation.  &lt;br&gt; Apathy or irritability.  &lt;br&gt; Increased blood pressure and heart rate.</td>
</tr>
<tr>
<td>Moderate hypothermia (28-32˚C)</td>
<td>Very cold skin and increasing pallor.  &lt;br&gt; Puffy face and generalised oedema.  &lt;br&gt; No complaints of cold.  &lt;br&gt; Speech difficult.  &lt;br&gt; Shivering stops and muscle rigidity develops.</td>
</tr>
<tr>
<td>Severe hypothermia below 28˚C</td>
<td>Extremely cold skin, extreme pallor, blue blotches, cyanosis.  &lt;br&gt; Death-like appearance.  &lt;br&gt; Muscle rigidity may become flaccid below 27˚C.  &lt;br&gt; Comatose and unresponsive to stimuli.  &lt;br&gt; Areflexia, pupils are fixed and dilated.  &lt;br&gt; Apnoea.  &lt;br&gt; No detectable pulse, ventricular fibrillation.</td>
</tr>
</tbody>
</table>

(Worfolk 1997)
Speed of rewarming

Methods to rewarm a patient should be appropriate to the level of hypothermia. Therefore, a prompt, effective, and individualised assessment is crucial. The speed of recovery for hypothermic patients depends on the length of time they have been exposed to the cold and their state of health at that time (Neno 2005). The effects of raising the temperature can increase the patient’s use of oxygen substantially. The aim, therefore, is to increase the temperature by no more than 1-2°C per hour (Brooker and Nicol 2003). Neno (2005) states it is important not to warm the patient too rapidly, suggesting that rewarming in mild hypothermia should be between 0.3 and 1.2°C hourly. However, if hypothermia is severe with cardiovascular instability present, rapid rewarming of up to 3°C hourly is necessary (Carson 1999).

If the temperature is allowed to increase too quickly the body may not be able to respond in time to this sudden increase. Consequently, oxygen consumption, myocardial demand and vasodilation all increase faster than the heart’s ability to compensate, which can result in the death of the patient (Brooker and Nicol 2003).

During rewarming ‘afterdrop’ can occur. This is the continued fall of core body temperature during rewarming. This is thought to be as a result of peripheral vasodilation and the release of cold peripheral blood into the internal organs which results in a drop in core body temperature (Elliot and Kiran 2006).

When active core rewarming is discontinued blood circulating to the peripheries is cooled and returns as cold blood to the core. This can reduce body temperature by as much as 2°C. As a consequence when active core rewarming is discontinued it is important to continue with active and passive rewarming strategies.

Conclusion

Hypothermia is a serious condition. Nurses need to be aware of thermoregulation and how the body responds when body temperature is dropping. Prevention is always better than cure. Nurses should, therefore, be aware of simple but effective prevention strategies for hypothermia and communicate these in an appropriate manner to patients most at risk. Early recognition of this condition (mild hypothermia) will allow for the timely implementation of passive rewarming management strategies.

If detected early enough and acted on quickly this should result in bringing body temperature back to within normal parameters. Active rewarming and active core rewarming strategies can be used in instances of moderate to severe hypothermia. Management should, therefore, be prompt and guided by the degree of hypothermia present. Core body temperature should be measured and strategies used to bring this core temperature gradually back to within normal parameters. Management during the acute phase should include airway management, fluid assessment and replacement, monitoring vital signs, ECG recording and assessment for hyperglycaemia. Rewarming strategies and the speed of rewarming should be appropriate to the degree of hypothermia NS.

References


Worfolk J (1997) Keep frail elders warm: the thermal instabilities of the old have not received sufficient attention in basic educational programs. Geriatric Nursing 18, 1, 7-11.