How to ensure patient observations lead to effective management of patients with pyrexia

There is considerable debate about the management of this common clinical condition. It is vital to know about treatment options to ensure optimal care produced in the body and heat lost to the environment. The most active organs, such as muscles, liver and digestive organs, produce the most heat. Skeletal muscle produces heat particularly following strenuous exercise and also during shivering. The liver is particularly active following a meal.

The majority of heat loss is through the skin and this depends on: the difference between the body and ambient temperature; the amount of body surface exposed to the environment; and the type of clothes worn. This heat loss can be controlled. Small amounts of heat are also lost during expiration, and in urine and faeces and this cannot be controlled (Waugh and Grant, 2006).

Fluctuations in body temperature can occur naturally as a result of circadian cycles, age, exertion/exercise, menstrual cycle, ingestion of food and ambient temperature (Marcovitch, 2005).

The maintenance of body temperature is essential for health and is achieved through

**USEFUL DEFINITIONS**
- **Pyrexia:** is an elevation of body temperature above the normal daily variation (NICE, 2007).
- **Core temperature >37.5°C** is considered a pyrexia (Leach, 2009).
- **Hyperpyrexia:** temperature >40°C (Dougherty and Lister, 2008).
- **Fever:** an abnormal rise in body temperature, usually accompanied by shivering, headache and, if severe, delirium.
- **Hyperthermia:** is a body temperature which is significantly above that of normal range.
- **Malignant hyperthermia:** is a rapid rise of temperature to a dangerous level (usually 41-45°C) (Leach, 2009; Marcovitch, 2005).

**BACKGROUND**
The human body maintains a normal temperature of about 37°C despite variations in metabolic activity and environmental temperature (Pocock and Richards, 2006). Recordings of body temperature provide an index of biological function and are a valuable indicator of patients’ health (Dougherty and Lister, 2008).

Abnormal body temperature, particularly pyrexia, is common in illness. However, a temperature >40°C is considered life threatening (Hussein, 2004) (see Box 1).

**GRADES OF PYREXIA**
There are three grades of pyrexia:
- **Low grade (normal to 38°C):** indicates an inflammatory response due to mild infection, allergy or disturbance of body tissue such as surgery, injury or thrombosis;
- **Moderate to high grade (38–40°C):** can be caused by an infected wound or soft tissue injury;
- **Hyperpyrexia (40°C and above):** causes include bacteraemia, injury to the hypothalamus, or high ambient temperature (Dougherty and Lister, 2008).

**RELATED ANATOMY AND PHYSIOLOGY**
Humans are described as homeothermic or having a core temperature that remains constant within a specific range, in spite of environmental changes (Dougherty and Lister, 2008). Normal body temperature ranges from about 36–37.5°C. Different regions of the body have different temperatures: for example, core temperature (temperature of the brain and organs within the thorax and abdomen) is the highest, while surface temperature (the skin) is the lowest (Pocock and Richards, 2006). Core temperature is the balance between heat loss and production.

**PRACTICE POINTS**
- Patients who develop pyrexia must be closely monitored following the airway, breathing, circulation, disability, exposure (ABCD/E) approach (Resuscitation Council UK, 2006).
- The cause needs to be identified and treatment of this, if indicated, started.
- Strategies to promote heat loss may be required.
negative feedback, so that any variation produces a physiological response to bring it back to a set point (around 37°C). The centre for regulating body temperature is in the hypothalamus of the brain (Fig 1).

This set point can be reset by substances called pyrogens (fever-producing proteins) released by monocytes and macrophages (phagocytic cells responsible for the body’s defence system). These act on the thermoregulation centre in the hypothalamus, causing the release of prostaglandins which reset the hypothalamic thermostat to a higher level. This triggers mechanisms to conserve and generate heat such as vasoconstriction and shivering, until the new set point temperature is reached (Waugh and Grant, 2006). This results in the development of pyrexia (Royal College of Nursing, 2008).

CAUSES OF PYREXIA

There are many causes of pyrexia including:
- Infection: 50% of pyrexia cases are due to infection (Leach, 2009);
- High ambient temperature: heat and humidity in the environment can reduce the amount of heat lost through the skin;
- Drugs: amphetamine derivatives, for example/methylenedioxymethamphetamine (ecstasy) and anaesthetics, can induce malignant hyperpyrexia (Leach, 2009);
- Stroke: leading to injury to the hypothalamus;
- Increased muscular activity: following strenuous exercise (particularly in a hot environment) and fitting;
- Endocrine: for example, thyroid storm;
- Myocardial infarction;
- Pyrexia of unknown origin: is a consistently elevated body temperature >37.5°C persisting for over two weeks with no diagnosis despite investigations (Boon et al, 2006). In 15% of cases either no diagnosis is made or the pyrexia resolves spontaneously (Boon et al, 2006).

ADVERSE EFFECTS ASSOCIATED WITH PYREXIA

Temperatures above 37.4°C or a trend of increase towards this level should prompt appropriate reporting, in line with early warning scoring systems.

Adverse effects linked to pyrexia include:
- Increased metabolic rate, increased oxygen consumption (10% rise with each 1°C increase in temperature) and increased production of carbon dioxide;
- Hypovolaemia due to sweating, dehydration and vasodilation;
- Metabolic acidosis;
- Epileptic fit;
- Neurological impairment;
- Renal failure;
- Rhabdomyolysis (rapid breakdown of muscle tissue);
- Death (Leach, 2009; Hussein, 2004).

Adverse effects are usually only associated with hyperpyrexia (>40°C).

NURSING CARE AND MANAGEMENT

Pyrexia is abnormal and should be considered an adverse sign. It is an important component of early warning scoring systems and can be associated with serious life threatening illness. Nursing care and treatment will be dictated by the severity of the pyrexia and its probable cause, patients’ condition, prognosis, local protocols and whether they are asymptomatic (feeling hot, sweating profusely).

General principles of care include the following:
- Assess patients following the airway, breathing, circulation, disability, exposure (ABCDE) approach advocated by the Resuscitation Council UK (2006). If necessary, summon expert help, administer high concentration oxygen and treat life threatening problems;
- Ensure early warning score (EWS) charts (or similar) are completed following local protocols; local EWS escalation policies should be followed;
- Monitor vital signs;
- Monitor fluid balance, ensuring patients remain adequately hydrated. Observe for signs of dehydration, particularly a prolonged capillary refill time of three seconds or longer, cool extremities and reduced urine output (RCN, 2008);
- Try to make patients as comfortable as possible. If they feel hot or are sweating profusely, consider gentle physical cooling methods to make them feel more comfortable, for example, careful use of a fan (see below). If patients are shivering, add a blanket to assist heat conservation (Brooker and Waugh, 2007). Cool, fresh and dry bed linens and clothing/nightwear usually help to make them more comfortable;
- Consider offering mouthwashes and ice to suck;
- If patients have life threatening hyperpyrexia, administer physical cooling methods (Leach, 2009; Wyatt et al, 2006; Brooker and Nicol, 2003);
- Do not routinely administer antipyretic drugs (see below);
- Try to establish the probable cause of the pyrexia.

Investigations

One approach to identifying the cause of pyrexia is to check the six Cs:
- Chest: does the patient have a chest infection?
- Cannula: is the cannula site infected?
- Calves: do they have a deep vein thrombosis?
- Catheter: do they have a urinary tract infection?
- C: do they have an infected wound?
- C: do they have an infected central venous catheter?

It may be necessary to send off sputum...
and urine samples for microbiology, culture and sensitivity. Blood tests may be taken for inflammatory markers.

**Cooling methods**

Opening a window or using a fan can make pyrexial patients feel more comfortable. The routine use of physical cooling methods, such as tepid sponging and fanning, are controversial. If the body’s natural defence mechanism to combat infection is to raise body temperature, why try to reduce it? Physical cooling methods may actually increase body temperature: they can stimulate a compensatory response by the hypothalamus, initiating heat generating activities such as shivering, which can compromise unstable patients by depleting their metabolic reserve (Brooker and Nicol, 2003).

There is no evidence to support the routine use of tepid sponging in temperate climates such as the UK, and it does not produce a sustained drop in temperature. It can cause vasoconstriction, which can result in a further rise in patients’ temperature (O’Connor, 2002). If it is performed too quickly, it can cause them to shiver, which will increase metabolic activity and subsequently core body temperature (Glasper and Richardson, 2006). It is also time consuming. NICE (2007) stipulated that tepid sponging should not be used in children under five years.

However, some authors recommend that physical cooling methods should be used if patients have potentially life threatening hyperpyrexia, heat stroke or malignant hyperthermia (Leach, 2009; Brooker and Nicol, 2003).

It could be argued that physical cooling methods can make patients feel weak, particularly during the early stage of pyrexia when temperature is still rising. Others support the view that these methods can make patients feel more comfortable (Fisher and Roper, 1987). There is no doubt that a cool fan (not directly on patients) or cool flannel on the face can be very welcome when feeling hot. If necessary, make patients more comfortable by reducing the amount of clothing and bedding.

**ANTIPYRETICS**

Antipyretic medication can be administered (British National Formulary, 2009). However, it is unlikely to be helpful (Leach, 2009) and can mask the symptoms of illness. The routine use of antipyractics is therefore not recommended (Wyatt et al, 2006).

**PYREXIA AND NEUTROPENIC PATIENTS**

Neutropenic patients are particularly prone to bacterial infections (reduced neutrophil count results in reduced ability to fight infection), and will usually be actively treated with broad spectrum antibiotic therapy if they develop a temperature (Boon et al, 2006). Local guidelines and protocols should be followed.

**MALIGNANT HYPERThERMIA**

Malignant hyperthermia is a rare but potentially fatal complication of anaesthesia and is characterised by a rapid rise in temperature, increased muscle rigidity, tachycardia and acidosis. It is treated with dantrolene administered by rapid IV injection (BNF, 2009).

**PYREXIA IN INFANTS AND CHILDREN**

Pyrexia is a common symptom in infants, children and young people, often indicating a self-limiting viral infection, rather than a bacterial or serious illness (RCN, 2008). However, every year 100 infants aged between 1-12 months die from infection, a number which could be reduced by improving the recognition, evaluation and treatment of febrile illness (NICE, 2007).

The treatment of pyrexia in infants and children is beyond the scope of this article. However, national guidance is available, which includes a recommendation that a “traffic light system” is used to identify serious illness (RCN, 2008; NICE, 2007).

**IMPORTANCE OF ACCURATE TEMPERATURE MEASUREMENTS**

Core body temperature measurements are taken to assess for deviation from the normal range, which may indicate disease, deterioration in condition, infection or reaction to treatment.

There has been much debate over the accuracy of different sites for temperature measurement compared with the gold standard pulmonary artery catheter, which is only used in a small group of critically ill patients (Trim, 2005). There are differences between sites and these are not necessarily consistent or predictable. Nurses should be aware of any influences on accuracy of the method used and should ensure both method and site are consistent and documented to help ensure accuracy and reliability. An in depth discussion of these issues can be found on page 10.

**CONCLUSION**

The management of pyrexia depends on the severity, cause and patients’ degree of ill health. Antipyretic drugs and physical cooling methods should not be used routinely. Hyperpyrexia is life threatening, usually requiring aggressive and prompt management to reduce temperature. Nurses should be familiar with the underlying physiology of temperature control and the causes of pyrexia so they can provide appropriate and informed care.