POSTOPERATIVE FEVER: Identification and Management

Stephen J. Miller, DPM

BODY TEMPERATURE AND REGULATION

Claude Bernard, a 19th century French scientist, felt that a delicate equilibrium is responsible for maintaining the stability of the body's internal environment. He termed this condition *milieu interieur* and it is approximately synonymous with the term homeostasis.

Homeostasis was the word coined by the American physiologist Walter Cannon, and refers to the maintenance of a steady state or equilibrium within the body. The purpose of any homeostatic mechanism is the preservation of the constancy of the internal environment. Body temperature is an example of a homeostatic mechanism. In the hierarchy of homeostasis, temperature regulation has the highest priority, subservient only to respiration. It supercedes acid-base balance, food balance, fluid volume maintenance, peripheral circulation and sleep.

To maintain temperature homeostasis, the body's core temperature must be delicately maintained within a set range, under conditions of varying thermal loads as detected by multiple thermal sensors. A reference point temperature may be fixed or otherwise, and is thought to be seated in the hypothalamus. This reference point is used during regulation for comparison to determine the appropriate responses in adjusting for detected temperature deviations. This reference is called the set point or set temperature.

Body temperature is an important and vital indicator of body homeostasis. (Table 1) It is controlled about a reference set point by a complex thermal regulatory system thought to be seated in the hypothalamus.

Table 1

DYNAMIC THERMAL EQUILIBRIUM

BODY HEAT PRODUCTION Metabolism	BODY HEAT LOSS Convection-radiation-vaporization
- Exercise	- Sweating/panting
- Shivering	- Change in temperature gradient
- Unconscious tensing of muscles	- Cooler environment
- Higher basal rate	- Decreased clothing
- Disease	- Increased air movement
- Specific dynamic action	- Increased radiation surface
- Food	

Adapted from Hockman CH: Temperature regulation: Central Nervous system mechanisms. In Godon (ed) *International Symposium on Malignant Hyperthermia*. Springfield, Il, Charles Thomas, 1973.

A single numerical figure (98.6° F) for normal core body temperature seldom fits the clinical situation. Instead, a range of normal between 97.1° and 99.5° F has been established as being more appropriate because the range may be extended in either direction by a variety of benign conditions. Most people exhibit a diurnal fluctuation in body temperature, with the lowest reading occurring between 4:00 am and 6:00 am and the highest reading between 8:00 pm and 11:00 pm. The variation ranges from 0.9° to 2.7° F.

FEVER

Fever is the abnormal elevation in body temperature which results from a disturbance of the thermo-regulatory mechanism. When temperature rises above the normal range, it is important to take into account normal fluctuation such as those caused by diurnal variation, menstruation, or exercise, all of which may appreciably add to the core body temperature under non-pathological conditions.

A more accurate definition of fever is an increase in temperature over what is normal for a given individual at that particular time of day, and not merely an isolated temperature greater than 98.6° F. It has been shown that temperature changes may occur postoperatively after extensive foot surgery, not associated with pathological conditions.

Table 2

Important Factors to Remember When Evaluating Postoperative Fever

Age
General Health
Length of Surgery
Type of anesthesia
Surgical trauma
Time since surgery
Drug therapy
Laboratory results
Status of Patient
- Pain
- Signs of Infection
- Urinary retention
- Constipation

MONITORING BODY TEMPERATURE

Body temperature is generally measured using one of three common devices: the mercury-glass thermometer, the disposable thermal-sensitive color indication thermometer, or the electronic thermometer with disposable jackets. Each of these devices has its own margin of error, which must be considered when evaluating results. Temperature can be taken either orally, in the axilla, or rectally, although the latter has been challenged as an inaccurate technique. There are a number of key factors to review when evaluating a postoperative temperature elevation. These factors are outlined in Table 2. One of the most accurate devices for measuring body temperature is the tympanic thermometer. It is important to use this accurate device when monitoring a patient for potential malignant hyperthermia.

EVALUATING POSTOPERATIVE TEMPERATURE CHANGES

Temperature elevation can be an important sign of potential complications. However, some ambiguity exists regarding the significance of postoperative temperature changes. (Figure 1)

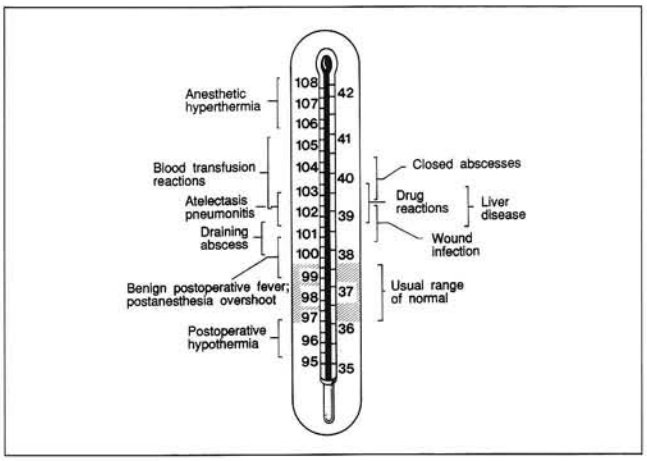

Figure 1. Causes of postoperative Temperature Elevations

During the first few hours after general anesthesia it is not unusual to observe a drop in body temperature of up to 2° F, more so in children. This is really a continuation of intraoperative hypothermia caused by interference with the hypothalamic thermoregulatory mechanism by general anesthesia. It is more pronounced in longer cases utilizing general anesthesia. The body must then expend great effort in order to reduce this heat deficit in the immediate postoperative period. The most dramatic manifestation of this is in the intense shivering observed as the body attempts to regain control of its set point. However, even without shivering, there is a considerable increase in oxygen consumption at this time. This increase is most likely indicative of the non-shivering thermogenesis taking place as the body attempts to raise its temperature.

In the absence of clinical signs and symptoms of a postoperative complication, a temperature rise of less than 2° F within the first 24 to 29 hours is probably a postanesthesia overshoot, which is actually a category of benign postoperative fever as was described by Roe. In one group of patients, Roe found that this phenomenon was not observed when the body temperature was successfully prevented from falling during the operation. Halothane has been proven not to be responsible for this phenomenon. For this reason, the patient must be kept as warm as possible during general anesthesia.

When mild postoperative temperature increases of less than 2° F are seen approximately 48 to 52 hours and 72 to 78 hours postoperatively, and there is an absence of any sign of complications, one may fairly make the diagnosis of true benign postoperative fever. These temperature elevations are thought to be caused by the leukocyte pyrogens released during the inflammatory reaction, after a threshold amount of tissue injury. No treatment is necessary for this temperature elevation, only observation and supportive therapy are required, and further investigation is unnecessary. For greater temperature increases, evaluation of postoperative fever can entail a lengthy differential diagnosis that must be narrowed by the interpretation of available data and the application of clinical experience.

The concept of set point helps explain the chill phase, characteristic of most sustained fevers. It is simply the body's attempt to catch up to the new thermostat setting by way of its normal thermoregulatory processes and effector mechanisms.

CAUSES OF POSTOPERATIVE FEVER

Higher fevers within the first twelve hours of surgery accompanied by cyanosis, hyperpnea, hypercapnia, hypoxia, tachycardia and decreased breath sounds point to possible atelectasis or a developing pneumonitis. The temperature characteristically peaks at about 102° F. If the postoperative fever is slightly higher, 103° to 104° F, and is seen anywhere along the postoperative course, notably within the first 48 hours, accompanied by more severe signs of respiratory distress then the diagnosis of pulmonary embolism secondary to a thrombophlebitic process should be considered. The embolus most likely comes from the veins of the lower extremities, particularly the soleal sinuses.

A significant temperature elevation of about 102° to 103° F either at or after 72 hours with associated signs of drainage erythema and persistent pain at the wound site should alert the surgeon to a potential infection development. Characteristically, the pain which should be abating at this time postoperatively, is actually exacerbated and difficult to control with strong analgesic. Sufficient time has elapsed for micro-organisms present in the wound site to proliferate in sufficient numbers to cause inflammation, release of pyrogens and fever.

Fever secondary to postoperative infection does not have to be limited to the wound itself. Other infection processes should be considered. Most frequently seen are lower respiratory tract infection, urinary tract infection and bacteremia. Other differential diagnoses include: drug fever, constipation, excessive pain, and benign postoperative fever. Fever has also been observed post "catheterization of the urethra". This is sometimes called a "catheter fever" and should be observed for 24 hours with appropriate cultures taken to rule out the introduction of bladder sepsis. (Table 3)

Table 3

POSTOPERATIVE TEMPERATURE CHANGES

Heat pyrexia Malignant hyperthermia Hypothermia	Intraoperative
Postoperative hypothermia Postanesthesia overshoot Atelectasis/pneumonitis	First 12 - 24 hours
Thrombophlebitis Pulmonary embolism Benign postoperative fever	Second 24 hours
Postoperative infection Urinary tract infection Benign postoperative fever Constipation	Third 24 hours
Drug fever Catheter fever Blood transfusion reaction Intravenous fever	Other Causes Appropriate to the Situation

TREATMENT OF POSTOPERATIVE FEVER

Treatment is best aimed at the associated pathological process instigating it. The use of antipyretic agents is discouraged until the cause of the fever has been determined or at least until a major pathologic condition has been ruled out. Mild fevers of less than 2° F require no pharmaceutical therapy unless that patient is uncomfortable as a result of marked debilitation. Once the cause of the fever is identified, antipyretic agents can be utilized in cases where the temperature elevation is marked or persistent. Drugs of choice are aspirin and acetaminophen. When fevers are resistant to salicylates, steroid preparations may be utilized.

Chasing postoperative fevers can be frustrating and expensive. Knowledge of thermoregulation and fever pathogenesis, especially in relation to surgery, provides better clinical insight for judicious patient management. Each fever should be carefully evaluated and the more dangerous etiologic causes ruled out.

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