PROGRESSIVE DYNAMICS MEDICAL

Hypothermia Presentation

Patient Forecast: 98.6 degrees.
Warm Air.
Sunny Outlook.

Thermoregulation

Thermal regulation is a balance between heat production and heat loss.

Despite marked changes in skin temperature, the body's homeostatic mechanisms are able to maintain a core temperature between 36 - 37.5° Celsius (96.8 - 99.5°F).

Real Temperature Model

Core Temp = 37.5°C / 99.5°F

Shell Temp = 34°C / 93.2°F (average)

Temperature = 37.5°C / 99.5°F

Hypothermia

- Hypothermia may be defined as a core temperature of less than 37° Celsius or 98.6° Fahrenheit
  - Mild = 37° to 33.1° Celsius
    = 98.6° to 91.6 ° Fahrenheit
  - Moderate = 30.1° to 33° Celsius
    = 86.18° to 91.4° Fahrenheit
  - Severe = 26.9° to 30° Celsius
    = 80.6° to 86° Fahrenheit

Hypothermia May Result as a Consequence of Surgery

- Contributing factors include:
  - Cold operating room temperature
  - Length of surgery
  - Age
  - Type of surgery
  - Type of anesthesia

Causes of Hypothermia

- General anesthesia
  - depresses the hypothermia thermoregulating center
- Skeletal muscle relaxants and central nervous system depressants
  - abolishes shivering and motor activity which are important homeostatic mechanisms to produce heat
- Drugs that cause vasodilation, accelerating heat loss.

Effects of Anesthesia

- When the affects of anesthesia are combined with
  - Cool intravenous fluid
  - Cold preparatory solutions
  - Exposed body parts

It is not surprising hypothermia may result.

Four Ways of Heat Loss from the Human Body

- Radiation
- Evaporation
- Conduction
- Convection

Major causes of heat loss during surgery are **convection** and **radiation**

Radiation

- It occurs via infra red radiation and is a function of surface area
  - Infants have a high surface area-to-body mass ratio therefore are particularly vulnerable to heat loss by radiation
- Radiant heat exchange accounts for the majority of heat loss to the environment around the body

Evaporation

- Occurs from
  - Surgical skin preparatory solutions
  - The airway
  - Exposed thoracic and abdominal viscera

Conduction

- Occurs when body tissues and fluids come into direct contact with colder materials such as:
  - Skin with cold objects such as metal tables
  - Cold intravenous fluids and blood products

Convection

Occurs as a result of the ambient air circulation that removes the air warmed by skin and viscera

The heat from the body is transferred to the circulating air

Adverse Affects of Hypothermia

- Cardiovascular System
- Respiratory System
- Immune System
- Vascular System
- Renal System
- Shivering
- Metabolic and Electrolytes

Cardiovascular System

- Hypothermia induces atrial and ventricular arrhythmias, vasoconstriction, increased blood viscosity and depression of ventricular function
  - This can result in hypertension and increased myocardial oxygen demand, which can cause in severe cases cardiac arrest

Respiratory System

- Mild hypothermia causes fast breathing, decrease in respiratory minute volume, bronchorrhea and bronchospasm
- Temperatures below 32°C (89.6°F) are associated with hypoventilation, loss of protective airway reflexes and inhibition of hypoxic pulmonary vasoconstriction
- Severe hypothermia can cause pulmonary edema

Coagulation/Immune System

- During hypothermia increased bleeding may occur due to reversible platelet dysfunction
- Hypothermia decreases immune function by impairing white blood cells ability to combat bacteria resulting in an increased susceptibility of surgical wounds to infection

Vascular System

- General decrease in blood flow to all organs
  - this is first seen in the skeletal muscles and extremities, followed by the kidneys and finally the flow to the heart and lungs is reduced

Renal System

- As the temperature decreases, the possibility of kidney failure increases, resulting in a progressive decrease in renal blood flow and the kidneys filtration rate
- These changes impair renal clearance of water soluble drugs and inhibit sodium and potassium re-absorption resulting in increased urine production

Shivering

- Increased oxygen consumption
- Increased heart beat
- Hypertension
- Metabolic acidosis
- Increased myocardial oxygen demand

Beneficial Effects of Hypothermia

- Mild hypothermia provides increased tissue tolerance to reduced blood flow, especially in cardiac and neurosurgical patients

Cost of Hypothermia

- Significant
  - increase in use of blood products
  - increase in ICU time and hospital stay
  - increase in infection, myocardial infarction, probability in receiving transfusions, mechanical ventilation and mortality

Cost of Hypothermia

- Hypothermia averaging only 1.5°C / 2.7°F results in adverse outcomes that negatively affect patient lives
- Depending on cost assumptions this can add $5,000 to $15,000 per surgical patient

Cost of Hypothermia

- Patients in whom normothermia has been maintained during surgery experience fewer adverse outcomes resulting in decreased costs
- Maintaining normothermia is significantly more cost effective than treating hypothermia

What is Convective Warming?

Convective warming is the transfer of heat through airflow

Methods of Warming

- Passive
  - increasing ambient air, warm cotton blankets, reflective thermal drapes and insulating blankets
- Active
  - convective patient warmers, IV fluid warmers, radiant warmers, circulating mattresses, and heated humidified gases

Convective Patient Warming

- Proven to be the most effective method of maintaining normothermia
- Greatly reduces both convective and radiant heat loss by eliminating the gradient between the patient and ambient air

Fluid Warming

- Effective in treating hypothermia when used in conjunction with convective warming
- Fluid warming is insufficient on its own to prevent hypothermia or restore normothermia expeditiously

Warming Blankets

- Select correct style and size
- Ensure hose is attached securely
- Secure the position of the blanket
- Place blanket directly against patient skin
- The warming blanket requires a cover, and when using, ensure airflow is not disrupted.
- Monitor temperature setting

LIFE-AIR 1000®

Soft-Flex®


Progressive Dynamics Medical offers patient warming blankets for all patients' needs.

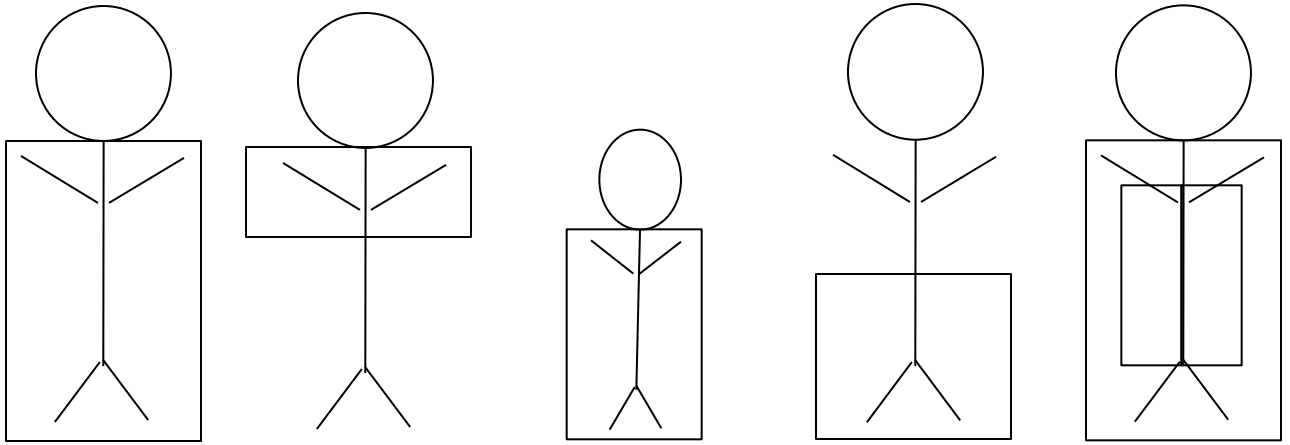
Soft-Flex®

- Patented piercing pattern for the flow of air from the cover to the patient provides a gentle bath of warmed air. Valves control how air is distributed.
- Flaps created when the cover is pierced function like a diffuser mixing up the air flow. This results in avoiding the potential of “hot” spots and reduces skin irritation.

Soft-Flex®

- Patented flexible pillow pattern in the SOFT-FLEX® Warming Cover allows care giver quick and easy access to the patient for either assessment or patient care.
- Material can be disposed of by the hospital's standard infectious waste incineration protocols. The by-products are: water vapor, carbon dioxide and a land fill non-hazardous ash.

Soft-Flex® Sizes



Upper Body Surgical
PD1103

Lower Body Surgical
PD1105

Recovery Room Adult
PD1101

Recovery Room Pediatric
PD1104

Full Body Surgical
PD1107

Convective Air Warming System

- Microprocessor controlled system, improves accuracy and safety.
- 5 temperature settings
- 0.2 micron 95 percent HEPA-filtration
- Retractable flashing over-temp light with audible oscillating warming tone
- Self-diagnostic, no special equipment required

References

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  - Temperature Regulation and Manipulation During Surgery and Anesthesia (May 1998). Grigore and Brusco, USA
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- Maintaining intraoperative normothermia: A meta-analysis of outcomes with costs.
  - Christine Brown Mahoney, RN PhD, MS; Jan Odom RN, MS, CPAN, FAAN, USA 1999