Fluid warming across care areas: blood transfusions

Blood transfusions touch a variety of patients who enter hospitals every day. Whether for emergency or elective surgery, transfusions affect a large number and wide variety of patients who include transplant patients, the chronically transfused, maternal patients, and newborns. According to the American Red Cross, a total of 30 million blood components are transfused each year in the United States to more than five million patients, with an average red blood cell transfusion of approximately three pints per patient.1

The magnitude of these transfusions implies that many departments beyond the operating room must be equipped to handle effective blood administration. These areas include blood center, NICU, and transfusion unit, as well as units that care for patients undergoing procedures such as bone marrow transplant, hemodialysis, therapeutic apheresis, and more.

A case for warm patients

While it is essential that blood is stored at very low temperatures to maintain its integrity, cold fluids can have negative implications for patients especially when it comes to their core body temperatures. Research has shown that 30 kCal of a patient’s energy are required to raise the temperature of cold 4 °C blood to 37 °C. So the infusion of two liters of cold blood could result in a body temperature decrease of between 1.0 °C and 1.5 °C,2 potentially leading to substantial hypothermia in patients.

Potential adverse effects of unwarmed blood

The infusion of unwarmed or inadequately warmed blood may contribute to these adverse consequences:

- Cardiac arrhythmia3,4,5
- Hemostasis abnormalities from impaired platelet function and slowed enzymatic reactions in the coagulation cascade3,4,5
- Peripheral vasoconstriction6
- Dehydration6
- Decreased oxygen delivery to tissues, which impairs oxidative killing of bacteria by neutrophils, and reduces the deposition of collagen during wound healing6
- Increased red cell release of potassium6
- Metabolic acidosis7
- Citrate toxicity (with blood component transfusion)8
**Potential adverse effects of hypothermia**

In addition to the potentially negative consequences directly attached to the transfusion of cold blood, patient hypothermia in general has been linked to additional adverse outcomes including:

- Impaired metabolism of drugs, prolonging the duration of some pharmacologic effects
- Compromised immune function
- Peripheral vasoconstriction
- Surgical-wound infection
- Severe shivering
- Prolonged recovery

In addition, injured patients with hypothermia have been shown to be more likely to die than normothermic patients with a similar injury severity score.

**Cost implications**

Accidental iatrogenic hypothermia has a major financial impact on a hospital’s annual resources, needlessly depleting budget that could be used for other needs. Normothermia is associated with substantially less blood loss and bleeding time compared with hypothermia, which can also increase wound site infections and lower productivity. In other words, precious resources and time cost money.

Case in point: In a meta-analysis using data from a 10-year period that included 18 studies and approximately 2,000 study patients, researchers found that even mild perioperative hypothermia (median temperature of 35.6 °C) led to a 16 percent increase in blood loss and a 22 percent increase in transfusion requirements, compared with patients whose temperatures were maintained at normothermia. Another study on the same topic in the perioperative environment, found that mild hypothermia as low as < 1 °C below normal increases blood loss by four percent to 26 percent and the relative risk of transfusion by three percent to 37 percent.

Hypothermia also impacts bleeding time. A 2 °C drop in body temperature produces a 100 percent increase in bleeding time. Patients in whom normothermia is maintained during surgery require 86 percent fewer units of red blood cells, 79 percent fewer units of plasma, and 78 percent fewer units of platelets than patients in hypothermic groups.

These hypothermic challenges impact a hospital’s usage, need and blood costs. The mean acquisition cost for one unit of red blood cells purchased from a supplier in 2011 was $210.74 ± $38. But it can get much higher depending on blood type and geographic region. Reduced reimbursement for erroneous administration of blood is another cost which should be considered when evaluating the value of reducing blood loss and bleeding time in patients.

**Ideal cases for fluid warming**

To fight hypothermia by minimizing thermal stress and maintaining thermal homeostasis, it is important to ensure the infusion of adequately warmed fluids to patients. According to the American Association of Blood Banks (AABB), blood warmers are recommended to maintain normothermia when transfusing blood into patients. The association notes that fluid warming is especially beneficial for major procedures where quantities and flow rates of transfused blood increase and transfusion-induced hypothermia becomes more likely.

**Analyze and trial**

The ECRI Institute recommends that clinicians analyze the patient's condition and consider the risks of heat loss when deciding whether or not to warm blood as it is transfused. When in doubt, they advise (especially with neonate, pediatric or elderly patients), that clinicians use a blood warmer and assess its effectiveness. ECRI advises that hospitals do not postpone setting up a warmer, as waiting until it is needed may interrupt the procedure, compromise the sterile field, and/or cause a significant drop in patient temperature. Additionally, blood warmers can help offset expected heat losses but cannot compensate for such losses once a patient’s temperature has begun to fall.

**enFlow® as a solution**

Preventing hypothermia is important throughout all areas of your hospital where blood transfusions and IV therapies occur. While there are various methods to keep a patient warm,
research shows that IV fluid warming works well when used along with other warming therapies, because heat transfer from warmed fluid is efficient, immediate, and independent of the peripheral-to-core temperature gradient. This method allows warmed blood to flow back to the core within seconds.\textsuperscript{16}

The enFlow\textsuperscript{®} IV fluid/blood warming system allows clinicians to warm blood products easily and efficiently across key hospital settings. The innovative design of the warmer enables it to be placed within inches of the IV site. The close proximity of the warmer reduces the potential for blood cooling within the IV line. Additionally, a blood warmer with a set point of 40 °C and audio/visual overheating alarms helps protect against overheating, which can cause hemolysis, osmotic fragility, O\textsubscript{2} saturation, and more.\textsuperscript{17,18}

Contact us
To learn more about the enFlow IV fluid/blood warming system for blood transfusions, please contact Customer Service at 800.323.9088 or visit carefusion.com/VitalSigns.

References