Hypothermia—In the Operating Room and Beyond

In this issue of RESPIRATORY CARE we are fortunate to have an article by Kempainen and Brunette[1] that offers the practitioner a reasoned treatise on hypothermia, its implications and treatments. As indicated by the authors, there are some 700 deaths per year from hypothermia in the United States; however, there are many more nonfatal cases per year, and also cases of hypothermia reported as some other malady. The surprise in Kempainen and Brunette's report is the decline in the number of cases in recent years. With the move to greater outdoor activity one would think the trend would be the opposite. Likely reasons for this could include: better outdoor gear on the market; the fact that with more people out and about, the person felled by or at risk of hypothermia is more likely to be encountered by others; improvements in housing and insulation materials; and that some recent winters may have been less cold than in prior years. As data accumulate, potential answers can be better evaluated.

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The hypothermia cases that attract media attention and interact with the medical community via the emergency services system are but a small part of the problem. The largest number of hypothermia cases develop right before our eyes in the operating room: most of the open heart surgeries (pediatric and adult) involve intentionally induced hypothermia, as do virtually all the operative cases that undergo general and regional anesthesia for more than 1 hour. The body-temperature drops in the latter cases are usually in the category of mild hypothermia (32–35°C), with fewer patients reaching moderate (28–32°C) or severe (28°C) hypothermia. With patients who are intentionally made hypothermic, all have a preplanned recovery strategy; this is usually the cardiac bypass circuit, an active internal rewarming mechanism of the extracorporeal type. As noted by Kempainen and Brunette, this, along with continuous arteriovenous rewarming, are efficient methods to quickly return body temperature to normal under observed conditions. In the nonoperative situation this is more of a struggle, as the entire apparatus must be available and mobilized with its support staff. In the other cases of observed, spontaneous hypothermia that perioperative staff manage, most are treated with active surface warming with forced air. This can be supplemented by warmed blankets, warmed intravenous solutions, or warming blankets. To maintain the efficiency of infusing warmed intravenous solutions, rapid infusers that have the capability to heat the solution during infusion are recommended. These are mostly touted for pre-hospital trauma resuscitation, but often are found in active emergency departments. They work best with rapid infusion rates and short tube lengths, which minimize heat loss during transfer from the device to the patient. In my experience, warming blankets are useless, cumbersome, and not worth the electricity. The best results are obtained with forced warm air and rapidly infused, temperature-controlled intravenous fluids. Maintaining the humidity of the inspired gas is a very easy way to maintain the patient's temperature and not risk further heat loss. As alluded to by Kempainen and Brunette, this is not the most efficient way to heat anybody larger than 10 kg, and it carries the risk of hypotonic fluid overload.

The pathophysiology of the hypothermic patient in the operative setting is often confounded by the operative procedure and intraoperative anesthetic management. The nonoperative patient poses the challenge of confounding illnesses or intoxication, which must be deduced while treatment commences. One constant that spans both situations is the effect of centrally active drugs on thermoregulation, whether at the hypothalamic, spinal, or other level. These adverse effects of drugs are often overlooked as sources of the hypothermia problem. The good thing about these drugs is that they ultimately dissipate as the temperature rises and the enzymes of metabolism and mechanisms of excretion return to full function. This makes knowing the specific drug contributing to the hypothermia less of an issue, unless a trial of a reversal agent, such as naloxone or flumazenil, is contemplated. In this case there is concern that the reversal agent will precipitate acute withdrawal and dramatic increases in oxygen utilization, with possible seizure activity in the case of benzodiazepines.

In the perioperative setting, one of the most important of the problems that bedevil us is shivering. As Kempainen and Brunette indicate, shivering is one of the body's methods of generating heat; however, it comes at a great metabolic and adrenergic cost, with great strain put on the cardiovascular system to supply greatly elevated quantities of oxygen. For the patient with marginal reserve and/or prone to rhythm instability this poses a great problem. Most practitioners of perioperative care prefer to forego

any heat generated by shivering and instead rely on passive heating mechanisms. Hence, most treat with centrally active drugs to reduce shivering (eg, meperidine, chlorpromazine) or nondepolarizing neuromuscular blocking agents. However, those drugs can reduce the accuracy of the bedside neurologic exam.

Finally, Kempainen and Brunette's excellent review of the pH-stat/alpha-stat controversy in blood gas management provides a good basis for discussion of the advantages, disadvantages, and physiologic rationale of each mode of management. The pH-stat/alpha-stat controversy truly equals the colloid-versus-crystalloid solutions for resuscitation controversy, with proponents on either side firmly basing their opinions on study, experience, and physiology. In all honesty, there have been no overwhelming data to support wholesale use of either one. In effect it appears that consistency of technique and treatment accordingly is the most useful approach. The pH-stat/alpha-stat controversy will probably remain a heuristic exercise for those whose clinical responsibilities are limited.

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REFERENCE

1. Kempainen RR, Brunette D. The evaluation and management of accidental hypothermia. Respir Care 2004;49(2):192–205.

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