

The impact of heat stress on OR clinicians

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The physiological and psychological impact of higher temperatures and humidity in operating rooms across America is real. Clinician comfort, satisfaction and performance are all affected, and traditional approaches to mitigating heat stress have not proven effective with any consistency, particularly for longer and more strenuous procedures such as orthopedic surgery. As surgeons and OR staff continue to work through the discomfort, cooling vests have proven to be an effective solution.

Examining the challenge of heat in the OR

Heat is a perennial pain point in operative settings, caused by temperature and humidity requirements aimed at preventing patient hypothermia. Established by the Facility Guidelines Institute of the American Society for Healthcare Engineering, these requirements are supported by both The Joint Commission and AORN.¹ The resulting higher temperatures can overheat OR clinicians and make them uncomfortable during surgery.

The impact of heat on OR clinicians is exacerbated by several factors. First, there is the need to wear several layers of personal protective equipment (PPE), including head covers, gloves and gowns. One notable example is the “spacesuits” and helmets worn during joint replacement surgery — which can worsen heat stress. Room temperatures in the upper limits of the ‘acceptable’ range are extremely uncomfortable to work in during any kind of physical surgery.

Indeed, heat stress can be even more impactful during long and strenuous procedures, including not only orthopedic, but also cardiac and neurological surgery. And even higher temperatures are required for pediatric and burn patient care.

The surgical gowns market has worked to mitigate the heat issue by developing lightweight and breathable fabric technologies. But only so much can be done without impacting the gown’s primary function of providing adequate fluid and pathogen protection.

So the challenges and effects of heat in the OR continue — and they can be significant. Combine the temperature and humidity requirements with hot surgical lights and PPE, the potential for heat stress is real. Those who don’t work in an OR every day might imagine it’s a cold environment. But body heat can’t escape the head covers, gloves and gowns that staff must wear for safety.

The challenge is about much more than personal comfort. Heat stress can impact not only the performance of clinicians, but also their long-term health. The consequences can be significant.

Assessing the impact

Heat stress is known to be associated with cognitive decline and affects stamina. The chronic stress response can be just as devastating — contributing to weight gain, depression and high blood pressure, while affecting long-term brain health and overall well-being.

In addition, heat stress can lead to OR inefficiency. For example, surgeons may pause during a procedure to change head covers, gowns and gloves; blot their faces, wipe off goggles that are fogging up and take breaks.

Surgeons aren’t the only ones affected by heat stress. OR staff are pulled away from other duties to tend to the surgeon’s heat stress-related needs — for example, blotting the surgeon’s face or calling maintenance staff to turn down the heat.

Ongoing research demonstrates that the consequences of heat stress are real.

A review of the literature

Here is a sample of the ongoing research addressing the regulatory standards that drive higher OR temperatures, the impact of wearing PPE and the consequences of heat stress on surgeons and OR staff.

Regulatory standards

According to the AORN Facility Reference Center, the recommended temperature range for the OR is 68 – 75 degrees.² Numerous studies explain the rationale for the higher temperatures, as well as document their impact on OR staff.

For example, a study published in *Global Cardiology Science and Practice* notes that “... room temperatures exceeding 23 degrees Celsius (74 degrees Fahrenheit) are generally required to maintain normothermia in patients undergoing all but the smallest procedures (and) most operating room personnel find such temperatures uncomfortably warm ... Because of its profound physiologic and pathophysiologic implications, temperature is a crucial homeostatic variable.”³

PPE exacerbates the problem

Personal protective equipment during surgery can heighten the effects of heat stress on OR clinicians. According to a study published in the *International Journal of Occupational Safety and Ergonomics*,

“Protective clothing worn in situations of external heat stress or intensive physical work may challenge the body’s temperature regulating system to such an extent that heat balance is no longer possible, which will result in heat storage and, consequently, the development of hyperthermia.”⁴

The consequences of heat stress

The physiological and psychological responses to heat stress occur in three phases:

1. Initial acute response: the “fight or flight” mechanism in the central nervous system, as well as an acute circulatory response that causes sweating and increases the heart rate and peripheral circulation. In addition, cells produce heat shock proteins (HSP) in response to the stress.
2. Balanced state during initial adaptation: the body acclimatizes and works to return to normal function.
3. Chronic activation: the long term, adverse effects — such as a decline in cognitive performance, increased corticosteroid production (leading to anxiety, depression, weight gain, heart disease and neurotoxicity), suppressed digestion, chronic kidney disease and an impaired immune response.

Numerous studies reveal how heat in the OR can impact staff performance. Here are three examples, cited in prominent medical and occupational health journals:

- From *Surgery*: “Heat stress is associated with decreased cognitive and psychomotor performance ... Even in the execution of short operative tasks, surgeons feel increased cognitive demands.”⁵
- From the *International Journal of Hyperthermia*: “Results (of this study) indicate that there was impairment in working memory with heat exposure ... Exposure to a hot environment is a competing variable to the cognitive processes ... Prolonged heat stress has been shown to have detrimental effects on reaction time.”⁶
- From *Journal of Occupational and Environmental Hygiene*: “Since heat stress can influence human cognitive function, increasing a worker’s comfort may improve awareness and decision-making, and therefore safety.”⁷

To help mitigate the impact of heat stress in the OR, “Cooling interventions are needed to decrease sweat activation, preserve cognition and improve physiological stress from barrier clothing.”⁸ Cooling vests have a history of effectiveness.

The use of cooling vests to reduce core body temperature

One solution for mitigating the impact of heat in the OR is the donning of cooling vests by surgeons and OR staff. These vests carry cooling packs in areas such as the front, shoulders and back to help lower core body temperature and maximize cooling — especially during long and labor-intensive procedures.

Cooling vests already have a track record of succeeding in other industries such as firefighting and have provided a roadmap for applying similar technology to the OR setting. According to a study in *Pediatric Quality and Safety*, “Cooling vests as worn by firemen and adapted to the surgical environment have been trialed in clinical settings. The preliminary tests have found measurable benefits in terms of lower skin temperature and sweat rates, leading to improved surgeon comfort.”⁹

Indeed, use of cooling vests in the OR has received positive feedback. Other members of the OR clinical team have seen benefits as well. According to one OR nurse, “These vests are designed by someone who knows what I go through.”

Solving an urgent problem

In healthcare today, there’s heightened awareness around the need for regulatory compliance, such as AORN and Joint Commission standards for regulating temperature in the OR. As a result, hospitals and health systems can’t lower OR temperatures for clinician comfort. Home remedies aren’t the answer, either — such as wearing cotton T-shirts, wrapping the forehead in gauze or taking the time to “invent” a solution to soak up the sweat.

To find the optimal solution to heat in the OR, stakeholders across the spectrum of healthcare can work together and share information. At stake is the safety and health of OR clinicians and patients alike. And options such as cooling vests are a viable strategy.

1 American Society for Healthcare Engineering. “Guidelines for Design and Construction of Residential Health, Care, and Support Facilities.” 2014. For additional guidelines for hospital settings, see: Facility Guidelines Institute. “Guidelines for Design and Construction of Hospitals.” Chicago, IL. American Hospital Association. 2018.

2 American Society for Healthcare Engineering. “Guidelines for Design and Construction of Residential Health, Care, and Support Facilities.” 2014. For additional guidelines for hospital settings, see: Facility Guidelines Institute. “Guidelines for Design and Construction of Hospitals.” Chicago, IL. American Hospital Association. 2018.

3 Saad, H., Aladawy, M. “Temperature Management in Cardiac Surgery.” *Global Cardiology Science and Practice*. March 2013, Vol. 2013, Issue No. 1, online, <http://dx.doi.org/10.5339/gcsp.2013.7>.

4 Reinertsen et al. “Optimizing the Performance of Phase-Change Materials in Personal Protective Clothing Systems.” *International Journal of Occupational Safety and Ergonomics (JOSE)*. 2008, Vol. 14, Issue No. 1, 43-53.

5 Berg et al. “The Impact of Heat Stress on Operative Performance and Cognitive Function during Simulated Laparoscopic Operative Tasks.” *Surgery*. Jan. 2015, Vol. 157, Issue No. 1, 87-95.

6 Gaoua et al. “Alterations in Cognitive Performance during Passive Hyperthermia Are Task Dependent.” *International Journal of Hyperthermia*. Feb 2011, Vol. 27, Issue No. 1, 1-9.

7 Kenny et al. “Ice Cooling Vest on Tolerance for Exercise under Uncompensable Heat Stress.” *Journal of Occupational and Environmental Hygiene*. Jul. 2011, Vol. 8, Issue No. 8, 484-491.

8 Zwolinkska3, Reinersten8, Gaoua24.

9 Hakim et al. “The Effect of Operating Room Temperature on the Performance of Clinical and Cognitive Tasks.” *Pediatric Quality and Safety*. March/April 2018, Vol. 3, Issue No. 2, e069.