Sci-Fi suspended animation: Not the same as cryonics but might save your life

News about suspended animation research has been circulating in popular media quite a lot over the last year or two, because of surgical research going on that may turn it from science fiction into science fact. The idea is that cooling the body to a cold temperature can stall death, until a victim of severe trauma can be repaired. The technology has remarkable potential that's backed by many years of non-human animal research.

But due to the science fiction sound of suspended animation, for many people the news may evoke images of Woody Allen waking up 200 years into the future after being frozen in the film *Sleeper*. Or they may think of Red Sox legend Ted Williams who was preserved cryogenically in liquid nitrogen after his death in 2002.

But while it's conceivable that suspended animation research could eventually reach the point of preserving people for extremely long periods of time, bringing them into a future when whatever is ailing them can be cured, that's not at all what's going in the clinical trials at a handful of medical centers around the United States. For this reason, the researchers are no longer using the term suspended animation, despite having used that term in numerous peer-reviewed scientific papers during preclinical testing involving dogs and pigs. It's probably a smart move. The general public doesn't read peer-reviewed medical journals, but they do watch a lot of science fiction shows, and sometimes having one's research conflated with science fiction can have a negative impact on how it is seen.

And so, the technique that's now under clinical study has a more medical sounding name: Emergency Preservation and Resuscitation for Cardiac Arrest and Trauma (EPR-CAT). While the goals of EPR-CAT are somewhat less ambitious than the Sleeper-esque goals of cryonics, EPR-CAT could be on the verge of saving many lives in the short term, of people with severe, blood-loss trauma would would otherwise die.

The other piece of good news is that, unlike cryonics, which is open only to very wealthy people, the nature of the clinical pilot study of EPR-CAT means that it could be used on anybody who is a good candidate. At institutions where the trial is underway, anyone who is a candidate based on their injuries can end up being treated with EPR-CAT, unless they have signed a form specifically requesting that they not be included in the study.

The only thing that EPR-CAT has in common with cryonics is the use of cold temperature to slow down chemical reactions in cells throughout the body. But the similarity ends there. Unlike cryonics, EPR-CAT is to be used in people who have not been declared dead. The main tactic in EPR-CAT is therapeutic hypothermia, which means that the patient's body temperature is reduced on purpose. Therapeutic hypothermia is not new in clinical medicine, but EPR-CAT takes it to a new level.

Hypothermia in standard medical practice

Nearly everybody is aware of the use of local hypothermia, the application of cold temperature to an isolated part of the body. You hurt you ankle and you apply ice, which lowers the temperature around the bruise, thereby reducing or preventing swelling. It’s a well-proven therapy that goes as far back as ancient Egypt. It’s also normal in medicine to induce hypothermia systemically, meaning lowering a patient’s temperature throughout the body. The most common setting for this is following a heart attack that is so severe that results in cessation of the heart beat and circulation of blood. In many such cases, the patients can be resuscitated using drugs and electrical shocks to the heart, but if nothing else is done the survival rate is very low, because of what’s called reperfusion injury. Return of blood flow through the brain cases damage and it’s thought to be related to the sudden reintroduction of oxygen into cellular energy organelles known as mitochondria.

To prevent this outcome, the American Heart Association (AHA) has guidelines for inducing hypothermia after resuscitation from cardiac arrest. The patient is kept unconscious and given drugs to prevent shivering while being cooled down to 33 – 34 °C. Since this is just a few degrees below the normal body temperature of 37 °C, it’s called mild hypothermia, and the patient is kept in this state for 24 hours.

Use of mild induced hypothermia over the last several has increased survival from cardiac arrest substantially and use of the procedure is expanding to other medical conditions. Along with drugs, mild hypothermia has been used to induce a therapeutic coma in victims of head trauma, because it protects the brain just as it does in the setting of cardiac arrest. For the same reason, it also is being studied clinically for use in treating strokes.

Uses more extreme hypothermia

Depending on the body temperature range, hypothermia is classified as mild (32 – 35 °C), moderate (28 – 32 °C), severe (20 – 28 °C), or profound (below 20 °C). Currently, use of hypothermia lower than the mild range is limited to very specialized and rare surgical procedures. Back in the 1950s, moderate hypothermia was under serious clinical investigation for open-heart surgery, and was used in highly publicized operations. The most famous case involved a 5-year-old child in 1952 who was labeled “the deep freeze girl” in a New York Times feature story. It was the first successful use of moderate hypothermia at 28 degrees (so, in reality, she was not even close to frozen) to enable surgical correction of what’s known as an atrial septal defect (ASD).

Today, ASDs are repaired routinely, but moderate hypothermia is no longer used. That’s because the lower body temperature, the deeper the hypothermia, the higher is the risk of complications, and soon after those pioneering operations in the 1950s another technology was perfected: cardiopulmonary bypass (CPB). In CPB, blood going into and out of the heart is bypassed through what’s known commonly as a heart-lung machine. Thus, while the heartbeat is stopped and the heart opened to allow surgery to correct defects, to replace valves, or to replace blood vessels (a common operation today known as coronary artery bypass surgery [CABG]), oxygenation of the blood and circulation to the brain and other vital organs can continue. In terms of potential complications, the cost-benefit has worked out in favor of using CPB and not moderate hypothermia for the most common heart operations that are performed today.

New age for hypothermia in medicine

Unlike routine clinical applications that involve mild hypothermia, EPR-CAT uses profound hypothermia. The more extreme the hypothermia, the longer the brain can survive without blood flow, so the idea is to reduce the patient's temperature to a level just above freezing temperature. The current clinical study is being run at a handful of medical centers, and the lead center is at the University of Pittsburgh, which has a long history of research in this area.

The leader of the EPR-CAT team at Pittsburgh is Samuel Tisherman, a trauma surgeon who developed the procedure in dogs and pigs over many years. Earlier in his career, Tisherman worked with another Pittsburgh hypothermia pioneer, anesthesiologist, the late Peter Safar. In the 1960s, together with James Elam, Safar invented what's now cardiopulmonary resuscitation (CPR). Early on, Safar proposed using hypothermia in the resuscitation process and the research being led today by Tisherman is a direct descendent of Safar's early work.

As opposed to mild hypothermia for heart attack victims, EPR-CAT will be used on people whose hearts have stopped due to traumatic blood loss. The usual challenge in such cases is that surgeons simply don't have enough time to repair the injuries and restore blood flow, before the brain has been without oxygen too long for the patient to survive. So, before attempting to make repairs, the EPR-CAT team perfuses the patient will cold fluids, bringing the body temperature down to a chilling 10 degrees or even 5 degrees. That profound hypothermia puts the person into suspended animation. Once the wounds are repaired, the volume of blood is increased and the heart is then restarted. The profound hypothermia also protects the brain from reperfusion injury.

If the first human subjects react to the EPR-CAT procedure similar to dogs and pigs, as they're expected to do, they'll be able to be kept in profound hypothermia –or suspended animation or whatever people wish to call it– for two or three hours and still be revived without brain damage. That may be a long way off from preserving people for two centuries or putting them into hibernation for a long voyage through space, but it could be a first step in that direction. In the meantime, it will bring the treatment of severe trauma patients, and their survival, into a new age.

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