NOBODY IS 'DEAD' UNTIL AFTER 4 HOURS OF EXPERT REVIVAL TECHNOLOGY, BUT FEW MEDICAL STAFF ATTEMPT IT

- Many so-called "dead patients" are not actually dead

- Insurance companies and hospital billing offices say it is cheaper for them to say some patients are "dead" than to go through the expense of reviving them

- Some emergency medical specialists are experts at bringing back the dead but large medical services never consult them

- New lawsuits against emergency rooms who do not go all the way with electrostim, ice cooling, brain electro-stim and other modern tactics

Back to Life: The Science of Reviving the Dead

Bill Bondar knows exactly where he died: on the sidewalk outside his house in a retirement community in southern New Jersey. It was 10:30 on the night of May 23, a Wednesday, and Bondar was 61—a retired computer programmer with a cherry red Gibson bass guitar, an instrument he had first picked up around the same time as Chuck Berry. He was 6 feet 1 and 208 pounds, down about 50 pounds over the last several years. On that night he had driven home from a jam session with two friends and, as he was unloading his car, his heart stopped. That is the definition of "clinical death," one of several definitions doctors use, not always with precision. He wasn't yet "brain dead," implying a permanent cessation of cerebral function, or "legally dead," i.e., fit to be buried. But he was dead enough to terrify his wife, Monica, who found him moments later, unconscious, not breathing, with no pulse. His eyes were open, but glassy—"like marbles," Monica says, "with no life in them. They were the eyes of a dead man."

In a general sense, we know what happened to Bondar. His doctor at the University of Pennsylvania Hospital, Dr. Edward Gerstenfeld, later determined that Bondar's left anterior descending artery was 99 percent blocked by a coating of plaque, leaving a passage "the width of a hair." A blockage in that vessel, the largest artery feeding the heart, is known to cardiologists as the widowmaker. A tiny clot lodging there would have sent his heart into a brief burst of the ineffectual rhythm known as fibrillation, before it stopped altogether. Within 20 seconds the hundred billion neurons in Bondar's brain would have used up their residual oxygen, shutting

down the ceaseless exchange of electrical charges that we experience as consciousness. His breathing stopped as he entered a quiescence beyond sleep.

About 250,000 times a year in the United States, someone's heart stops beating on the street, or at home or at work. This can be the result of a heart attack, when a clot chokes off a coronary artery, or a host of other conditions including congenital defects, abnormal blood chemistry, emotional stress and physical exertion. Without CPR, their window for survival starts to close in about five minutes. Life or death is mostly a matter of luck; response time to a 911 call varies greatly by location, but can exceed 10 minutes in many parts of the country. In rough numbers, they have a 95 percent chance of dying.

How long has it been since you've read an article about heart attacks that didn't mention saturated fats? Our age is obsessed with "health," but when health fails, the last line of defense is in the emergency room, where doctors patrol the border between life and death—a boundary that they have come to see as increasingly uncertain, even porous. This is a story about what happens when your heart stops: about new research into how brain cells die and how something as simple as lowering body temperature may keep them alive—research that could ultimately save as many as 100,000 lives a year. And it's about the mind as well, the visions people report from their deathbeds and the age-old questions about what, if anything, outlives the body. It begins with a challenge to something doctors have always been taught in medical school: that after about five minutes without a pulse, the brain starts dying, followed by heart muscle—the two most voracious consumers of oxygen in the body, victims of their own appetites. The emerging view is that oxygen deprivation is merely the start of a cascade of reactions within and outside the cells that

can play out over the succeeding hours, or even days. Dying turns out to be almost as complicated a process as living, and somehow, among its labyrinthine pathways, Bondar found a way out.

Monica tried to recall what she had learned in a CPR class decades earlier. She bent over Bondar and began pushing down on his chest, then rushed back to the kitchen to dial 911. "My husband is dying!" she gasped to the operator.

Compressing Bondar's chest would have sent a trickle of blood to his brain, supplying a fraction of its normal oxygen consumption, not enough to bring him back to consciousness. But the West Deptford police station was only three blocks away, and within two minutes of Monica's call three officers arrived with a defibrillator. They placed the pads on Bondar's chest, delivered two jolts of electricity to his heart, and got a pulse back. Soon paramedics arrived with oxygen and rushed him to a nearby community hospital. The report Monica received there after an hour was equivocal: Bondar was "stable"—his heart rate and blood pressure back to near normal—but he was still in a coma. It was then that Monica made a decision that may have saved his life. She asked that her husband be moved the 15 miles to Penn, the region's leading university hospital.

Dr. Lance Becker, director of Penn's year-old Center for Resuscitation Science, frequently dreams about mitochondria: tubular structures within cells, encasing convoluted membranes where oxygen and glucose combine to produce the energy the body uses in moving everything from molecules across cell membranes to barbells. Recently mitochondria have been in the news because they have their own DNA, which is inherited exclusively down the female line of descent, making them a useful tool for geneticists and anthropologists.

But Becker is interested in mitochondria for another reason: he believes they are the key to his audacious goal of tripling the time during which a human being can go without a heartbeat and still be revived. That the five-minute rule is not absolute has been known for a long time, and the exceptions seem to involve low temperatures. Children who fall through ice may survive unexpectedly long immersions in cold water. On Napoleon's Russian campaign, his surgeon general noticed that wounded infantrymen, left on the snowy ground to recover, had better survival rates than officers who stayed warm near the campfire. Becker is hoping to harness this effect to save lives today.

Becker is 53, slender and boyish in a way that belies his thinning hair; his typical greeting to colleagues is a jaunty "What's up, guys?" For his lab he has assembled a high-powered team from a wide range of specialties, including a brilliant young neuroscientist, Dr. Robert Neumar; an emergency-medicine specialist, Dr. Ben Abella; plus cardiologists, biochemists, bioengineers and a mouse-heart surgeon. His associate director, Dr. Vinay Nadkarni, comes from pediatrics. Becker has in effect re-created at Penn, on a more ambitious scale, the laboratory he founded in 1995 at the University of Chicago, with a grant of $50,000 from the philanthropist Jay Pritzker. Ten years earlier Pritzker had walked into the emergency room at Chicago's Michael Reese Hospital complaining of chest pains, and crumpled to the floor. Becker resuscitated him, the beginning of both a rewarding friendship (Pritzker lived for 14 more years) and a new direction for Becker's career. "Every day since then," he says, "I would go home and wonder why Jay Pritzker got a second chance and so many other people didn't."

Becker's interest in mitochondria reflects a new understanding about how cells die from loss of circulation, or ischemia. Five

minutes without oxygen is indeed fatal to brain cells, but the actual dying may take hours, or even days. Doctors have known for a long time that the consequences of ischemia play out over time. "Half the time in cardiac arrest, we get the heart going again, blood pressure is good, everything is going along," says Dr. Terry Vanden Hoek, director of the Emergency Resuscitation Center at the University of Chicago, "and within a few hours everything crashes and the patient is dead." It took some time, though, for basic research to supply an explanation. Neumar, working with rats, simulates cardiac arrest and resuscitation, and then examines the neurons at intervals afterward. Up to 24 hours later they appear normal, but then in the next 24 hours, something kicks in and they begin to deteriorate. And Dr. James R. Brorson of the University of Chicago has seen something similar in neural cells grown in culture; deprive them of oxygen and watch for five minutes, or even much longer, and not much happens. "If your car runs out of gas, your engine isn't destroyed, it just needs fuel," he says.

Cell death isn't an event; it's a process. And in principle, a process can be interrupted. The process appears to begin in the mitochondria, which control the cell's self-destruct mechanism, known as apoptosis, and a related process, necrosis. Apoptosis is a natural function, destroying cells that are no longer needed or have been damaged in some way. Cancer cells, which might otherwise be killed by apoptosis, survive by shutting down their mitochondria; cancer researchers are looking for ways to turn them back on. Becker is trying to do the opposite, preventing cells that have been injured by lack of oxygen from, in effect, committing suicide.

It's a daunting problem. "We're asking the questions," says one leading researcher, Dr. Norm Abramson of the University of

Pittsburgh. "We just haven't found the answers." Until recently, the conventional wisdom was that apoptosis couldn't be stopped once it was underway. It proceeds by a complex sequence of reactions—including inflammation, oxidation and cell-membrane breakdown—none of which seems to respond to traditional therapies. Becker views cell death in cardiac arrest as a two-step process, beginning with oxygen deprivation, which sets up the cell for apoptosis; then the heart starts up again and the patient gets a lungful of oxygen, triggering what is called reperfusion injury. The very substance required to save the patient's life ends up injuring or killing him.

Researchers have ransacked their arsenal of drugs looking for ways to interrupt this sequence. Over the years they have tried various techniques on nearly 100,000 patients around the world. None has shown any benefits, according to Dr. A. Michael Lincoff, director of cardiovascular research at the Cleveland Clinic. But one thing does seem to work, something so obvious and low-tech that doctors have a hard time accepting it. It's hypothermia, the intentional lowering of body temperature, down to about 92 degrees Fahrenheit, or 33 Celsius. Research by a European team in 2002 reported favorable results from a controlled study of several hundred cardiac-arrest patients; subjects who were cooled both had better survival rates and less brain damage than a control group. The first big international conference on cooling took place in Colorado this February. Despite favorable studies and the endorsement of the American Heart Association, "we were concerned that [hypothermia] still wasn't catching on," says the conference organizer, Dr. Daniel Herr of Washington Hospital Center in Washington, D.C. The two leading manufacturers of cooling equipment—Medivance, Inc., and Gaymar Industries—say only about 225 hospitals, out of more than 5,700 in the United States, have installed machines for inducing hypothermia. Herr says the treatment requires a "paradigm shift" by doctors. "People

have a hard time believing that something as simple as cooling can make such a big difference." Perhaps that's because no one quite understands how cooling works. It appears to work globally on apoptosis, rather than on any of the individual biochemical pathways involved in it. "The short answer is, we don't know," says Neumar.

Researchers have also been looking into the way patients get oxygen during resuscitation, and afterward. The treatment goal in cardiac arrest has been to rush oxygen to the heart and brain at maximum concentration; the mask the paramedic pops on your mouth supplies it at 100 percent. "The problem with that," says Dr. Ronald Harper of UCLA, "is it does some very nasty things to the brain." Harper believes a mixture containing 5 percent carbon dioxide would buffer those negative effects, but the idea is still controversial. At the University of Maryland, Dr. Robert Rosenthal and Dr. Gary Fiskum have been looking into whether oxygen concentrations should be dialed down much more aggressively. In their lab, dogs with induced cardiac arrest recovered better when they were taken off full oxygen after just 12 minutes, compared with an hour in the control group. Rosenthal says in practice patients sometimes are left on pure oxygen for much longer than an hour—in one hospital he studied, for as much as 121 hours.

At Penn, Becker's Resuscitation Center coordinates with the Emergency Department on a protocol for cooling patients in cardiac arrest. "We look at their prior mental state," says Dr. Dave Gaieski. "If someone was in a coma in a nursing home, we're not going to cool them." The same goes for patients whose hearts stopped for longer than an hour. Since 2005 just 14 patients have met Penn's criteria for hypothermia. Eight survived, six of them with complete recovery. No one knows how many others were saved by cooling around the country.

Bondar arrived at Penn at about 1:30 a.m., still comatose, minutes ticking away while he was evaluated for cooling. Once the decision was made, the team sprang into action, injecting him with an infusion of chilled saline—two liters at about 40 degrees—then wrapping him in plastic tubes filled with chilled, circulating water. Becker believes, based on animal work, that cooling patients even sooner—ideally, on their way to the hospital—would be even more effective, and part of the work of his lab involves perfecting an injectable slurry of saline and ice that could be administered by a paramedic. Bondar was kept at about 92 degrees for about a day, then allowed to gradually return to normal temperature. He remained stable, but unresponsive, over the next three days, while Monica stayed at his bedside. She finally went home Sunday evening, and was awakened Monday by a call from the hospital that she was sure meant bad news.

"Guess what?" said the voice on the other end. "Bill's awake."

Bondar's first words were, "How did I get here?" He had lost track of a full week, from about two days before his heart attack until he woke up. That's not unusual; short-term memory is often the first casualty of cardiac arrest. Neumar says certain cells in the hippocampus, the part of the brain that forms new memories, are for unknown reasons especially sensitive to ischemia. Another Penn patient, Sean Quinn, was 20 and a student at Drexel University when he went into unexplained cardiac arrest in 2005. He was one of the earliest patients cooled at Penn, and there's reason to believe that it saved his life, but the continuing memory deficit has prevented him from returning to college.

Certainly, people do not form memories while they're in a coma. Exactly one year before Bondar had his heart attack, Brian Duffield, then 40, a salesman in Tucson, collapsed in the shower

after a swim. Luckily for him, he was on the campus of the University of Arizona, whose hospital uses a cooling protocol similar to Penn's. "I was there one minute and the next thing I know, it's a few days later and people are telling me I was dead and came back," says Duffield. But Duffield's memory and intellect and personality all returned intact from his brush with death, as did Bondar's. This is, on some level, deeply mysterious. We experience consciousness embedded in time, a succession of mental states continually re-created in our brains, even during sleep. But when the brain shuts down, where does the mind go?

That is the crux of one of the oldest debates in philosophy. The materialist view is that Bondar's memories resided in the physical state of the cells and synapses of his brain, a state that is preserved for some period after the heart stops beating. Becker has pronounced perhaps a thousand deaths in his career, but often with the feeling that—despite the lack of pulse, breathing or discernible brain function—something vital remains in the body on the bed. He felt it most strongly when his own father died of cardiac arrest at the very hospital where Becker was working in 1993. When Becker saw him, he was already dead, but something seemed preserved. "I just had the sense he wasn't really dead yet," Becker says. "He was dead. He had been pronounced. But he hadn't left."

This is the belief motivating people who pay to have their bodies frozen in liquid nitrogen after their deaths, in the hope that they can someday be thawed and restored to life. The Alcor Foundation, in Scottsdale, Ariz., has signed up about 825 prospective patients, and has preserved 76 of them, including Ted Williams. These aren't all whole bodies; some people opt for just their heads, which, apart from being cheaper, freeze faster than an entire body, reducing the danger of frost damage to the cells. Of

course, we are a long way from knowing how to reanimate a frozen body, let alone just a head. One possibility, according to Tanya Jones, chief operating officer of Alcor, is to take a cell from the head and clone a new body to attach it to. The other is to scan the entire three-dimensional molecular array of the brain into a computer which could hypothetically reconstitute the mind, either as a physical entity or a disembodied intelligence in cyberspace. This, obviously, is not for the impatient. The physicist Ralph Merkle, an Alcor board member, has used this idea to popularize a fourth definition of death: "information-theoretic" death, the point at which the brain has succumbed to the pull of entropy and the mind can no longer be reconstituted. Only then, he says, are you really and truly dead.

But there's another answer to the question of where Bondar's mind was during the last week of May. This is the view that the mind is more than the sum of the parts of the brain, and can exist outside it. "We still have no idea how brain cells generate something as abstract as a thought," says Dr. Sam Parnia, a British pulmonologist and a fellow at Weill Cornell Medical College. "If you look at a brain cell under a microscope, it can't think. Why should two brain cells think? Or 2 million?" The evidence that the mind transcends the brain is said to come from near-death experiences, the powerful sensation of well-being that has been described by people like Anthony Kimbrough, a Tennessee real-estate agent who suffered a massive coronary in 2005 at the age of 44. Dying on the table in the cath lab during angioplasty, he sensed the room going dark, then lighter, and "all of a sudden I could breathe. I wasn't in pain. I felt the best I ever felt in my life. I remember looking at the nurses' faces and thinking, 'Folks, if you knew how great this is, you wouldn't be worried about dying'." Kimbrough had the odd sensation of being able to see everything in his room at once, and even into the next room. He is one of about 1,200

people who have registered their experiences with a radiation oncologist named Dr. Jeffrey Long, who established the Near Death Experience Research Foundation in 1998 to investigate the mystery of how unconscious people can form conscious memories.

That's also what motivates Parnia, who has begun a study of near-death experiences in four hospitals in Britain, aiming for 30 by the year-end. The study will test the frequently reported sensation of looking down on one's body from above, by putting random objects on high shelves above the beds of patients who are likely to die. If they later claim to have been floating near the ceiling, he plans to ask them what they saw. Parnia insists he's not interested in validating anyone's religious beliefs; his idea is that death can be studied by scientists, as well as theologians.

As for Bondar, his mind stayed put during his ordeal, which ended when he went home with Monica on June 1, nine days after he died. Gerstenfeld had given him an implantable defibrillator, cleared his blocked artery and inserted a stent to keep it open. "He came back fully intact," says Gerstenfeld. "He was dead, if only for a few minutes. But it could have been much worse. He could have been dead-dead."

We are, Becker believes, at the forefront of a revolution in emergency medicine destined to save millions of lives in the years ahead. This is doctoring at its most basic, wresting people back from death. "I have been fighting with death for 20 years," he says. "And I'll keep doing it, I think, until I meet him in person."

Man Revived After Being Dead for 18 Hours

By Olivia Rowe -

An unnamed Frenchman has survived a heart attack, despite his heart stopping for 18 hours, *Daily Mail* reports.

The man managed to avoid death because his heart attack occurred outside and his body temperature fell rapidly after he suffered hypothermia.

“The medical team was stupefied,” said Jonathan Charbit, who’s in charge of the intensive care unit at Montpellier University Hospital in southern France. The 53-year-old was apparently resuscitated after he was found unconscious by a river.

The man was walking back from his brother’s house in Beziers on March 12. When he didn’t return home, family members searched for him and found him by the river.

“The probability of him surviving was near to zero,” Charbit added. He went on to say that the man survived because the decline in his body temperature protected his organs, in addition to emergency workers trying to revive him after they discovered the cold preserved his body.

3comments

Heart massages were performed on the patient for more than four hours before he was able to be placed on a heart-lung machine, which kept him alive until his body temperature became

warm enough for doctors to make a last successful attempt to get his heart pumping again.

The patient is still on respiratory support but his now able to walk. The head of the intensive care unit, Xavier Capdevila, said the man is “heading towards a total recovery.”

Man revived after being dead for 18 hours

Doctors battled to save the man's life. Image Credit: Anastasia Puscian / US Navy

The 53-year-old was resuscitated despite lying lifeless outside with no heartbeat for the better part of a day.

The man, whose name has not been disclosed, was only saved because the near-freezing conditions outside had brought on hypothermia, causing his body's core temperature to plummet.

He was found unconscious next to a river on March 12th after suffering a heart attack while on his way back from his brother's house in southern France.

Realizing that the cold had helped to preserve his organs, doctors spent hours attempting to revive him. Incredibly, following one last desperate effort to save his life, his heart started beating again.

"The medical team was stupefied," said Jonathan Charbit, head of the intensive care unit at Montpellier University Hospital in France. "The probability of him surviving was near to zero."

According to reports, the man is still on respiratory support but has not suffered any brain damage.

"He is heading towards a total recovery," said Charbit.

Source: [The Times]

'Back from the dead': Man dies by electrocution before doctors revived him 20 minutes later

Shelby Tankersley,

Michael Pruitt and Dr. Angel Chudler. Chudler helped save Pruitt's life after he died of electrocution.

Michael Pruitt and Dr. Angel Chudler. Chudler helped save Pruitt's life after he died of electrocution. (Photo: Provided)

DETROIT — Michael Pruitt was working outside when he was electrocuted, resulting in the untimely death of the young man in suburban Detroit. But after 20 minutes, doctors had him back on this side of reality.

Pruitt, 20, had been working on a job outside in the western suburb of Livonia with his father on April 30 when a metal ladder he was carrying hit a live wire, electrocuting him.

“I remember being electrocuted while holding that ladder and shaking, and then nothing,” Pruitt said in a news release.

Livonia Fire and Rescue was on the scene after four minutes, and paramedics performed what they hoped would be lifesaving CPR and defibrillation.

But Pruitt died before they made it to the hospital. That didn't deter anyone, though.

Once at Beaumont Hospital in Farmington Hills, doctors continued to shock Pruitt with defibrillation until his heart started beating again.

Because doctors increased the voltage they used with the defibrillators, Pruitt was revived after two minutes at the hospital.

Dr. Angel Chudler, who worked on Pruitt, recalled saying, "You better come back" to the man's lifeless body.

And he did come back. Medical professionals on the scene said Pruitt woke up with full strength and it took a number of people to restrain and keep him from shaking himself out of his hospital bed.

Jillian Pruitt, Michael's mother, said she was happy to have her son back and is even happier that he's the same man he was before he died.

Typically, brain cells start to die after just five minutes, and registered nurse Barbara Smith said it was "miraculous" that Pruitt still has all of his brain function, including his sense of humor.

“I knew he’d be OK when Michael made a sarcastic gesture when I asked if he had any other superpowers," Jillian Pruitt said. "My first-born had returned from the dead."

The only scars Pruitt sustained were burns on his big toes where the electricity left his body. But he made a mark of his own to commemorate the experience.

Pruitt now has a tattoo sitting over his heart of "the sacred all-seeing eye of God inside a triangle surrounded by a Native American dream catcher" to remember that fateful day.

Follow Shelby Tankersley onTwitter: @shelby_tankk

Pro/con ethics debate: When is dead really dead?

Leslie Whetstine,[1] Stephen Streat,[2] Mike Darwin,[3] and David Crippen  corresponding author4

Abstract

Contemporary intensive care unit (ICU) medicine has complicated the issue of what constitutes death in a life support environment. Not only is the distinction between sapient life and prolongation of vital signs blurred but the concept of death itself has been made more complex. The demand for organs to facilitate transplantation promotes a strong incentive to define clinical death in a manner that most effectively supplies that demand. We consider the problem of defining death in the ICU as a function of viable organ availability for transplantation

Go to:

The scenario

A 45 year old female patient arrives in the emergency department after having complained of a headache and progresses to unresponsiveness. She is placed on mechanical ventilation and a CAT scan of her brain shows massive intracranial bleed. The family is assured she will probably progress to brain death but she doesn't. After two days in the intensive care unit she continues with gasping ventilations and some flexion to pain in one arm. All other brain functions are absent. Her hemodynamics and other organ function are stable. The family desires the patient to be an organ donor but she is clearly not brain dead. It is suggested to the family that the patient can still donate under the 'Donation after Cardiac Death' (DCD) rules. Life support can be withdrawn and she can be pronounced dead using asystole as a criterion rather than brain death, following which organs can be taken for transplantation after a variable period of time to rule out 'auto-resuscitation'. Would you recommend this procedure?

Go to:

Patients cannot donate organs until they are dead

Leslie Whetstine

The question that arises from this case is: Is the DCD donor truly dead at the moment of organ recovery? The answer depends on two things: first, on what concept of death we are using; and second, what version of irreversibility we find most compelling. It is beyond the scope of this analysis to examine the appropriate conceptual definition of death, but suffice to say that the traditional concept of death is the irreversible cessation of the integrated functioning of the organism as a whole. I will argue that DCD does not fulfil this definition.

The Uniform Determination of Death Act (UDDA) [1] established that death could be declared by either the irreversible cessation of circulatory functions or the irreversible cessation of the entire brain, including the brain stem [2]. DCD advocates cite this statute as evidence that DCD is a legitimate practice using the circulatory criterion. The UDDA may appear to support DCD but only if we construe a bifurcated rather than a unitary definition of death that does not require the permanent cessation of the organism as a whole but only of certain parts of it. The UDDA claimed it did not suggest two different types of death but that either of the two criteria were necessary and sufficient conditions for death. We cannot embark on a critical analysis of this legislation here but it has three primary shortcomings: First, it failed to define the critical term 'irreversible'; second, irreversible absence of circulation is sufficient for death but not necessary; and third, irreversible absence of circulation may be a mechanism of death, but it is not death itself, which has always been regarded as brain death. As

quoted from the *New England Journal of Medicine* [3], "It is clear that a person is not dead until his brain is dead. The time honoured criteria of the stoppage of the heart beat and circulation are indicative of death only when they persist long enough for the brain to die."

Advocates of DCD take a soft-line interpretation of irreversibility. They argue that if resuscitation has been proscribed and if the person cannot spontaneously resuscitate (auto-resuscitation), the person is irreversibly dead as a practical matter. But a moral decision to not restore function does not ensure the clinical state of death has been fulfilled. Moreover, inability to auto-resuscitate cannot be used to determine when death has occurred as many people who cannot auto-resuscitate can be resuscitated with an intervention. Finally, the time period in which auto-resuscitation may occur has not been sufficiently studied to make a determination that two or five minutes of asystole will preclude it. The fact that a person proscribes resuscitation or cannot auto-resuscitate does not make one dead at that precise moment, but prognosticates death and suggests one has entered a dying process that may ultimately lead to irreversible death.

Organ donation operates under the dead donor rule (DDR), which stipulates that organs may not be removed prior to death nor may organ procurement cause or hasten death. DCD fails to satisfy the DDR on three counts: First, it manipulates the definition of irreversibility based on a moral position not to resuscitate; second, it appeals to fallacious logic that because one cannot auto-resuscitate then one is dead; and third, it focuses solely on the circulatory criterion endorsed by the UDDA, which does not immediately correlate with brain status. Generally speaking, using the circulatory criterion would not be problematic as its absence will inevitably cause total brain failure. In DCD, however, the need

for speed becomes a factor such that organs will be removed before the requisite time it takes for the brain to die as cessation of cardio-respiratory functions does not cause the brain to die immediately.

If the body can be resuscitated, we have to question if it was ever really dead given our conventional notion of death as a finality from which one cannot be returned or resurrected from under any circumstances. DCD protocols remove organs from a donor who is not irreversibly dead; if the whole brain is not yet dead, the patient cannot be dead.

Go to:

Donation after cardiac death is consistent with good medical practice

Stephan Streat

The issue of how death is certified, if this is 'according to good medical practice', does not determine my approach to organ donation. Whetstine, however, finds this "the question" for non-heart-beating donation and advances three arguments why this should be so. First, I am unconvinced that death hasn't occurred because 'irreversibility' hasn't been established. Strictly speaking, no prospective definition of 'irreversibility' is possible. Only after all possible reversal strategies have failed can a situation truly be said to have been, in retrospect, 'irreversible'. In the circumstance of possible non-heart-beating donation, such strategies would be morally repugnant and contrary to acceptable clinical practice. I agree with Cole [4] that inclusion of the concept of 'irreversibility' is a deficiency of the Uniform Determination of Death Act (UDDA) [1]. But this semantic difficulty does not arise in many countries, including my own, that do not have a statutory definition of death.

Second, I understand how Whetstine's concern with 'irreversibility' has led her to consider the concept of auto-resuscitation but the UDDA is silent on this concept, as it is on the means by which death should be determined, requiring only that it must be "in accordance with accepted medical standards" [1]. Although "lack of auto-resuscitation after a certain time interval" might be a reasonable "accepted medical standard", there is no general consensus on whether this is an appropriate operational approach to "irreversibility" or on what that "certain time interval" might be and a dearth of reported evidence to inform that discussion.

The phenomenon of return of spontaneous circulation (ROSC) after discontinuation of cardiopulmonary resuscitation (CPR) was first reported in 1982 [5] and later termed the 'Lazarus phenomenon' [6]. A more recent review of 25 reported cases found that the exact timing after stopping CPR until the detection of ROSC was usually uncertain but could have been as long as 20 minutes in one case [7]. These authors suggested, "after cessation of CPR, each patient should be further monitored (at least clinically and with an ECG) for at least 10 minutes (the typical time interval for a Lazarus phenomenon)." However, the phenomenology of similar events after circulatory arrest following extubation in the presence of severe brain damage may or may not be the same as those occurring after discontinuation of CPR (which has usually included, for example, several doses of adrenaline and other therapies).

In most jurisdictions where non-heart-beating organ donation occurs, a 10 minute period of circulatory arrest (asystole on ECG and no pulsatility by arterial line) has been accepted as sufficient to determine that "death has occurred" [8], whereas the US Institute of Medicine recommended that a five minute period was sufficient [9]. Dutch law requires a further five minute 'no touch' period after death has been declared before any measures to procure organs can begin, similar to recommendations by the US Institute of Medicine.

Finally, Whetstine suggests that non-heart-beating donation springs solely from the circulatory criterion endorsed by the UDDA and, because the cessation of circulation does not cause the brain to die immediately, that the brain, and thereby the patient, might still be alive at the time that organ procurement begins. Although I agree that some parts of the previously severely damaged brain might be able to function if oxygen transport was immediately

restored (even after perhaps 10 minutes of circulatory arrest), I see this concern as similar to her concern with irreversibility of circulatory arrest. There is no way to tell if the brain is dead after such a period of circulatory arrest, other than by restoring and maintaining oxygen transport and determining whether any signs of brain activity return. Such an operational approach to 'brain death' is not required by the UDDA or good clinical practice.

My own concerns in non-heart-beating organ donation are for the medical acceptability of the methods used to certify death, the independence of this process from the organ retrieval process, the manner in which the option of organ donation is discussed with the family and the acceptability of all of these processes to everyone involved. I do not believe that organ donation should ever be 'recommended' to families, only that under appropriate clinical circumstances, perhaps including this one, it is an 'option' that should be 'sensitively offered'.

Go to:

A thoughtful analysis of death in the ICU

Mike Darwin

death \'deth\ n 1:

a permanent cessation of all vital functions: the end of life

Webster's New Collegiate Dictionary

The fundamental questions are, simply, what and when is death? This problem is not new: In the seventh century, Celsus wrote, "Democritus, a man of well merited celebrity, has asserted that there are in reality, no characteristics of death sufficiently certain for physicians to rely upon" [10].

Both Streat and Whetstine essentially concede defeat in dealing with these two pivotal questions in the first paragraph of their respective analyses. While sidestepping the core issue of what is the "appropriate conceptual definition of death", Whetstine then argues compellingly that DCD does not meet either the intent or the criteria set forth in the UDDA. Streat argues compellingly that the issue of irreversibility is a practical impossibility to determine, and that because of this, utilitarian criteria should prevail in determining when death is pronounced and when organs may be retrieved.

The earliest definitions of death are arguably religious and largely binary; a person is either clearly dead or alive on the basis of whether a metaphysical spirit, soul, or life force continues to animate the physical body. The departure of the soul is synonymous with unequivocal death of the person and the only obligations that remain are ritually appropriate corpse disposal.

This worldview is extremely valuable as it satisfies the practical and emotional needs of people for certainty, closure and clarity. With the advent of CPR and life support systems, the formerly binary status of life and death became increasingly analogue. The advent of transplantation served only to further degrade the binary view of death by allowing the continued 'survival' of the organism in a fragmented way in the bodies of others.

Because all other functions of human life could be medically enabled to persist after the loss of personal identity, the Harvard Committee properly focused its attention on the sole organ that enables or produces this property; the brain. As both Streat and Whetstine agree, however, the problem of what constitutes 'irreversible' was left unaddressed, and this is a critical flaw in any absolute definition of death. It is obvious that a solid majority of patients dying today could be resuscitated and supported artificially with intact mentation, albeit only at tremendous cost, both in terms of resources and suffering.

The brain is a discrete pattern of atoms, each as effective as the next as long as the unique pattern of their arrangement persists. Presumably all of the attributes of personhood are encoded in this lattice. This view allows us to view the person as 'information beings', defined by the arrangement of particular atoms that comprise our brains at any moment. So long as that pattern of information can be recovered, the person is not dead. If a cookbook is ripped to pieces it is no longer functional; it is impossible to read or use. The torn pages still contain all the information required, however, to allow for the book to be pieced back together and restored to a functional, useful state. By contrast, if the book is burned and the ashes stirred, the loss is irreversible given our current understanding of physical law (the limitations imposed by both the laws of thermodynamics and

information theory). This approach to defining death, which is rooted not in relative, changing technology and vitalistic worldviews, but rather in the fundamentals of physical law, is known as the information theoretic criterion of death [11].

As Merkle [11] has stated:

"A person is dead according to the information theoretic criterion if their memories, personality, hopes, dreams, etc. have been destroyed in the information theoretic sense. That is, if the structures in the brain that encode memory and personality have been so disrupted that it is no longer possible in principle to restore them to an appropriate functional state then the person is dead. If the structures that encode memory and personality are sufficiently intact that inference of the memory and personality are feasible in principle, and therefore restoration to an appropriate functional state is likewise feasible in principle, then the person is not dead."

The utility of the information-theoretic criterion of death to this case and this discussion is to point out that few if any patients pronounced dead by today's physicians are in fact truly dead by any scientifically rigorous criteria. A further and even more disturbing complication is the rapidly advancing technology of organ cryopreservation [12]. Using ice-free cryopreservation methods (vitrification), reversible long-term function of the mammalian kidney has been achieved after cooling to -135°C (Fahy GM: *Vitrification as an approach to cryopreservation [abstract]*. Presented at the 42nd Meeting of the Society for Cryobiology, Minneapolis, Minnesota, USA, July 24–27, 2005). Using essentially the same techniques, investigators have been able to achieve indefinite cryopreservation of the mammalian brain with intact ultrastructure and substantial preservation of metabolic and

electrophysiological activity [13]. Long-term reversible cryopreservation of the mammalian brain would, in effect, enable most of today's terminally ill or even 'DCD' patients to engage in speculative medical time travel in pursuit of a cure [14], further complicating the issue of when death is.

But speculative science not withstanding, we must return to the conundrum of when and how to pronounce death in the case at hand, and others even more vexing, where there is an unarguably uninjured and intact brain at the time medicolegal death is pronounced. Real-world examples are conscious and competent patients on ventilator, left ventricular assist device (LVAD) support, or other kinds of life support who wish for the withdrawal of treatment and subsequent donation of vital organs [15]. Rigorously defined, death is a slow process and can only be assured when autolysis of the brain is far advanced or completed. Both the stability of brain ultrastructure and the recovery of viable neurons after hours of cardiac arrest are well documented [16]. Clearly, such a lengthily post-arrest interval for declaring medicolegal death is neither practical nor humane.

Both medicine and the law should respond to this problem with common sense, compassion and flexibility. It is only the ideologue or the fool who acknowledges noon and midnight, but denies all the states of light and darkness that smoothly shade together in the real world to create day and night. Patients who are not candidates for further medical intervention to save or prolong their lives should be pronounced dead based not on the absolute or theoretical irreversibility of their pathology, but rather on the basis of the permanence of this condition; namely, that there will be no attempt to resuscitate, revive, or otherwise seek to continue the patient's life. In the current milieu, this means the use of whatever clinical criteria under the law are appropriate at a time

when further therapeutic interventions are medically ineffective, or are rejected by the patient, or his duly authorized medical surrogate.

Streat summarizes the course physicians should follow succinctly:

"My own concerns in non-heart-beating organ donation are for the medical acceptability of the methods used to certify death, the independence of this process from the organ retrieval process, the manner in which the option of organ donation is discussed with the family and the acceptability of all of these processes to everyone involved. I do not believe that organ donation should ever be 'recommended' to families, only that under appropriate clinical circumstances, perhaps including this one, it is an 'option' that should be 'sensitively offered'."

As Streat notes above, the critical factors are informed consent, lack of advocacy or conflict of interest in the organ retrieval process, and a medical determination of the permanence of the condition (i.e., inappropriateness of further life prolonging efforts).

The issue of auto-resuscitation, which is so problematic to Whetstine, should be considered in the context of a simple, real-world test. If a patient who terminates LVAD or ventilator support is duly and legally pronounced dead at the time of cardiorespiratory arrest, would it be homicide to fire a bullet into his brain one minute later? The contemporary medical and legal answer is clearly 'no'. Thus, the administration of appropriate drugs to prevent medically contraindicated auto-resuscitation in the context of a modality that would not otherwise be applied to the dead patient without his consent is morally and legally permissible, as well as being a great humanitarian good. Post-pronouncement administration of a cardioplegic dose of

potassium chloride, in addition to an electrocortically suppressive dose of barbiturate or diprivan, to prevent ROSC and possible recovery of some degree of consciousness during post-pronouncement CPR, extra-corporeal support, or rapid *in situ* blood washout with organ preservation solution, would seem not merely desirable, but an ethically mandated part of the standard of care. You cannot kill a patient who is already medicolegally dead.

Defining death in morally absolute terms is technologically, if not scientifically, impossible at this time. Attempts to use rigid, binary, black or white, all or none approaches will only serve to recreate the bitter futility of similarly barren arguments that have characterized the debate over when life begins (and the attendant social and medical issue of abortion). In the real world, death is a continuum, and it should be dealt with as such. That means thoughtful judgment on the part of patients, physicians and lawmakers as to where to draw lines in that shifting sand. If the informed consent of the patient is the foremost value, there will be little moral risk in deciding just how dark it must be before night has fallen.

Go to:

DCD: a work-around of the rules we need to consider carefully

David Crippen

The rules for the interpretation of death by whole brain death (WBD) criteria were formulated over 20 years ago in an age of only moderate technological innovation. In 2005, it may be that modern critical care medicine has modified the entire concept of WBD, mandating replacement by a new paradigm taking into account our ability to discern shades of grey in brain function. Those shades of grey have become the focus of much debate as we try to find the line separating 'alive enough to donate' and 'dead enough to bury'.

These paradigm shifts not withstanding, the rules set out for the determination of death as it pertains to organ donation are very clear even in 2005. Patients must be dead before organs can be taken for transplantation. Traditionally, 'brain death' has been necessary for a patient to be declared legally dead for procurement of organs for transplantation [3]. The concept of DCD is a creative interpretation of the DDR [17], equating the aftermath of cardiac death with the presence of brain death. Many more patients could be used for donorship using cardiac death criteria.

But these concepts are not synonymous. Brain death is a diagnosis that death has occurred. Cardiac death is a prognosis that death is inevitable (using WBD criteria). The rules set down by the UDDA [1] suggest that death must be irreversible. Patients with cardiac standstill may not necessarily be brain dead, and may actually be resuscitatable if anyone chose to do it [18]. The criteria to make that determination must be both necessary and sufficient for

death. It is necessary and sufficient that the entire brain has irreversibly ceased to function. Loss of a heartbeat is sufficient but not necessary in the presence of WBD. In this regard, DCD is a very creative interpretation of the DDR using utilitarian criteria. Patients may not be necessarily 'dead' by the rules, but they're 'dead enough' after cardiac standstill if death is inevitable. A seemingly small issue, but with big picture implications.

The big picture of all workarounds and creative interpretation of the rules is more daunting than the short-term benefits. The rules for organ donation are poorly amenable to bending, lest we find ourselves bidding for organs on eBay [19] or harvesting suspicious operating room deaths as in *Coma* [20]. Enthusiasm and aggressive marketing techniques to raise public consciousness about organ donation are not necessarily compatible with rules in place to protect public rights.

Now that this workaround has been popularized, further creative interpretations of the rules are inevitable. Anything that increases the desired supply of organs could be fair game. Why not allow families to simply authorize mining for paired organs from incompetent relatives before death, and then withdraw life support on the basis of futility? Further, why not mandate that everyone is a donor unless they sign up with an 'I don't want to donate' registry? Now that the foot is in the door, and not much cry of foul has been forthcoming, more workarounds are on the way and each one will be an escalation of creative interpretation slanted toward increasing demand, perhaps at the cost of individual rights. This is the major reason why a very public discourse must continue on the subject of how we interpret the rules for organ donation.

Go to:

Competing interests

The author(s) declare that they have no competing interests.

Go to:

References

1. Uniform Determination of Death Act http://www.law.upenn.edu/bll/ulc/fnact99/1980s/udda80.htm
2. Joynt RJ. A new look at death. J Am Med Assoc. 1984;252:681. doi: 10.1001/jama.252.5.680. [CrossRef] [Google Scholar]
3. Sweet WH. Brain death. N Eng J Med. 1978;299:410–412. [PubMed] [Google Scholar]
4. Cole D. Statutory definitions of death and the management of terminally ill patients who may become organ donors after death. Kennedy Inst Ethics J. 1993;3:145–155. [PubMed] [Google Scholar]
5. Linko K, Honkavaara P, Salmenperä M. Recovery after discontinued cardiopulmonary resuscitation. Lancet. 1982;1:106–107. doi: 10.1016/S0140-6736(82)90242-2. [PubMed] [CrossRef] [Google Scholar]
6. Bray JG. The Lazarus phenomenon revisited. Anesthesiology. 1993;78:991. [PubMed] [Google Scholar]
7. Maleck WH, Piper SN, Triem J, Boldt J, Zittel FU. Unexpected return of spontaneous circulation after cessation of resuscitation (Lazarus phenomenon) Resuscitation. 1998;39:125–128. doi: 10.1016/S0300-9572(98)00119-1. [PubMed] [CrossRef] [Google Scholar]
8. Bos MA. Ethical and legal issues in non-heart-beating organ donation. Transplantation. 2005;79:1143–1147. doi: 10.1097/01.TP.0000160761.86036.6C. [PubMed] [CrossRef] [Google Scholar]
9. Institute of Medicine, National Academy of Sciences . Non-heartbeating Organ Transplantation: Medical and Ethical Issues in Procurement. Washington, DC: National Academy Press; 1997. [Google Scholar]

10. Walker AE. Cerebral Death. 2. Baltimore-Munich: Urban and Schwarzenberg; 1981. p. 166. [Google Scholar]
11. Merkle RC. The technical feasibility of cryonics. Med Hypotheses. 1992;39:6–16. doi: 10.1016/0306-9877(92)90133-W. [PubMed] [CrossRef] [Google Scholar]
12. Fahy GM, Wowk B, Wu J, Phan J, Rasch C, Chang A, Zendejas E. Cryopreservation of organs by vitrification: perspectives and recent advances. Cryobiology. 2004;48:157–178. doi: 10.1016/j.cryobiol.2004.02.002. [PubMed] [CrossRef] [Google Scholar]
13. Lemler J, Harris SB, Platt C, Huffman T. The arrest of biological time as a bridge to engineered negligible senescence. Ann NY Acad Sci. 2004;1019:559–563. doi: 10.1196/annals.1297.104. [PubMed] [CrossRef] [Google Scholar]
14. Martin GM. Brief proposal on immortality: an interim solution. Perspect Biol Med. 1971;14:339–340. [PubMed] [Google Scholar]
15. DeVita MA, Snyder JV, Arnold RM, Siminoff LA. Observations of withdrawal of life-sustaining treatment from patients who became non-heart-beating organ donors. Crit Care Med. 2000;28:1709–1712. doi: 10.1097/00003246-200006000-00002. [PubMed] [CrossRef] [Google Scholar]
16. Konishi Y. Isolation of living neurons from human elderly brains using the immunomagnetic sorting DNA-linker system. Am J Pathol. 2002;161:1567–1576. [PMC free article] [PubMed] [Google Scholar]
17. Veatch RM. The dead donor rule: true by definition. Am J Bioethics. 2003;3:10–11. doi: 10.1162/152651603321611791. [PubMed] [CrossRef] [Google Scholar]
18. Bernat JL. A defense of the Whole Brain concept of death. Hastings Center Report. 1998;28:14–23. [PubMed] [Google Scholar]

19. eBay http://www.ebay.com
20. Cook R. Coma. London: Macmillan Publishers; 1977. [Google Scholar]

Biotech company thinks it can bring brain-dead people back to life

Chris Smith

AMC's *The Walking Dead* is a huge hit, and so are many other movies and TV shows about zombies. But as much as we love these undead thrillers, we wouldn't want to actually come across zombies in real life... or would we? One biotech company in the U.S. will move forward with plans to attempt to revive dead people. Specifically, the company is looking to see if the brain activity can be regenerated in brain-dead people so that death can be reversed.

DON'T MISS: Apple's future is more exciting than you can even imagine

A trial to see if it's possible to revive dead brains won approval in the U.S., *The Telegraph* reports. And the study might be groundbreaking if it yields any positive results.

Bioquark has been granted permission to recruit 20 patients who have been declared clinically dead from traumatic brain injury to see whether parts of their central nervous systems can be brought back to life. Scientists will use a combination of methods to try to reactivate the brains. They will inject the brain with stem cells as well as a cocktail of peptides, and use lasers and nerve stimulation

techniques that have been successful at bringing patients out of comas.

The patients will have been certified dead and they'll be monitored for months after inclusion in the study. Brain imaging equipment is supposed to show any signs of regeneration, particularly in the upper spinal cord. Doctors will look to see whether independent breathing and heartbeat control can be regenerated.

"This represents the first trial of its kind and another step towards the eventual reversal of death in our lifetime," Bioquark CEO Ira Pastor said. "We hope to see results within the first two to three months."

Bioquark founder, president, and chief science officer Dr. Sergei Paylian added, "Through our study, we will gain unique insights into the state of human brain death, which will have important connections to future therapeutic development for other severe disorders of consciousness, such as coma, and the vegetative and minimally conscious states, as well as a range of degenerative CNS conditions, including Alzheimer's and Parkinson's disease."