

Cryopreservation Case Report:

The Cryopreservation of Patient A-1562

by Tanya Jones

Background

A 39-year old man when he was pronounced legally dead, A-1562 joined Alcor nearly ten years before he needed our help. At the time he signed the donation paperwork, he had received treatment for AIDS for nearly ten years. His condition was under control for a long time, before his immune system finally began to succumb to the disease. Throughout his final months, the patient became increasingly reluctant to discuss his condition, even with his closest family. In the weeks prior to the case, however, his significant other (who is also an Alcor member) grew concerned and fortunately remained in close contact with Alcor. We were informed that we could be needed again in Florida before too much time had passed.

Alcor's emergency response system was activated by the patient's significant other for the final time in mid-April of 2004. Complications had manifested. In addition to his AIDS, the patient was suffering from a host of other diseases as part of this terminal decline, including: a recent diagnosis of Hodgkin's lymphoma, hepatitis B and C, liver and renal failure, and sepsis. He was admitted to the hospital during his final weeks for a radically enlarged liver and testicles. Additional symptoms included fatigue, fevers, anemia, lactic acidosis, and jaundice. His doctors were unsure of the cause of this decline but were suspicious that they related to experimental medications the patient was taking. They were not confident about the chances for our patient surviving both the chemotherapy he needed and any additional treatment for the new symptoms.

Stabilization and Transport

The transport and cryoprotection teams were notified of the known infectious risk. Universal precautions were expanded to include coveralls and goggles for all team members and the use of puncture-resistant nitrile gloves underneath the standard latex gloves.

When Alcor was contacted about this latest hospitalization, the patient's physicians were not expecting him to survive more than a day or two. We informed our Florida team of the situation on April 19, 2004, and launched a standby of four paramedics that lasted two days. During this time, I discussed Alcor procedures with the hospital staff, including the patient's primary care physician and charge nurses.

As with all such cases, our preparations included

communicating with the hospital staff on what they could do if the patient's heart stopped prior to the arrival and preparation of the standby team. We faxed a copy of our Emergency Stabilization Instructions to the doctor, which included an introduction to cryonics and the procedures we use during stabilization. These instructions request hospital personnel administer intravenous medications (diprivan, heparin, streptokinase, epinephrine, and gentamicin) while performing chest compressions for several minutes to circulate them, administer Maalox through a nasogastric tube to prevent internal bleeding, and surround the patient in ice.

As many medical personnel do, the nurses at this hospital felt uncomfortable providing treatment to a legally dead individual, and the patient's physician chose to refer our directives to the hospital administrators. After a legal department and ethical review, the application of this protocol was approved, and the orders entered in the patient's chart.

During this time, the patient had been scheduled for chemotherapy, but his doctor felt he was too weak for the procedure. The treatment was postponed, and the patient began to recover. Our standby team was sent home after a couple of days, as his condition stabilized.

On April 23, we received an urgent call from the hospital informing us that the patient's condition was worsening once more, and we directed the Florida team to the Miami hospital again. Once on-site, team members spoke with the patient's significant other

A-1562 Fracture Events

| date | time | time, post-pronouncement | temperature | max voltage |
|-----------|----------|--------------------------|-------------|-------------|
| 4/30/2004 | 3:58:26 | 71.553 | -128.4 | 0.1 |
| ° | 4:01:45 | 71.611 | -128.4 | 0.04 |
| ° | 4:59:01 | 72.576 | -129.1 | 0.44 |
| ° | 5:10:10 | 72.763 | -129.4 | 0.4 |
| ° | 6:54:52 | 74.496 | -131.6 | 0.19 |
| ° | 10:37:23 | 78.204 | -134.7 | 0.3 |
| ° | 12:57:03 | 79.258 | -136.2 | 1.2 |
| ° | 12:57:03 | 79.258 | -136.2 | 0.15 |
| ° | 12:57:03 | 79.258 | -136.2 | 0.6 |
| ° | 12:57:03 | 79.258 | -136.2 | 0.07 |
| ° | 20:28:34 | 88.054 | -145.2 | 0.12 |
| ° | 0:12:14 | 91.837 | -157.3 | 0.42 |
| ° | 0:48:04 | 92.375 | -166.9 | 0.15 |
| ° | 2:05:54 | 93.697 | -172.5 | 0.09 |
| ° | 2:24:20 | 93.977 | -172.9 | 0.15 |

and verified the hospital and funeral home arrangements were in place. Medication doses were calculated, drawn, and placed on ice; and the team settled in to wait nearby.

After the midnight shift change among the team members, one paramedic remained with the patient, while another took a now off-duty member home. At about 06:00 (EST), we received a call that the patient had taken a turn for the worse. The patient's doctors had decided to cease most treatment and to allow the natural progression of the diseases to take their inevitable course. By the time the absent team member returned, the patient had been pronounced legally dead. The hospital staff administered the emergency stabilization protocol as agreed.

The local funeral home provided transport of the patient from the hospital to their facility. Upon the arrival at the funeral home, two team members donned personal protective equipment to protect them from the infections this patient carried and administered the rest of the transport medications. Because of the limited number of personnel at the scene, no notes were taken on this stage of the protocol administration. The local coordinator reports that all medications were administered and chest compressions continued for the specified length of time, and then the patient was prepared for transport to Arizona. We had been fortunate to have local funeral home contacts ready, available, and experienced in cryonics transport, as the result of all the activity in Florida that year.

No field washout was performed in this case for two reasons. The first reason was the patient's rapid decline. The team felt it likely the patient would be pronounced while they were en route to the funeral home, and setting up the equipment would then take time away from more urgent patient care. The second reason was the patient's highly infectious status. More time was needed to properly prepare the field equipment and operating area to

minimize the health risks to the staff.

The patient was prepared for transport, but the team neglected to include the DuaLogR recording device, so there are no transport temperatures for this case. This is an oversight that has occurred in several cases in recent years, so Alcor is working to find a data collection solution that will eliminate this critical loss of data.

Cryoprotection

After changing planes once in Atlanta, the patient landed safely at the Phoenix Sky Harbor airport at 20:35 (MST). He was transported to the Alcor facility by our local funeral director within 36 minutes of the plane's landing. Prior to his arrival, we held an infection control meeting with the operating room personnel. Though we hold similar meetings on a regular basis, we felt it useful to remind everyone of the necessary precautions for safely handling contaminated material or sharps, for minimizing the number of personnel in the operating room, and for the effective use of engineering controls and personal protective equipment.

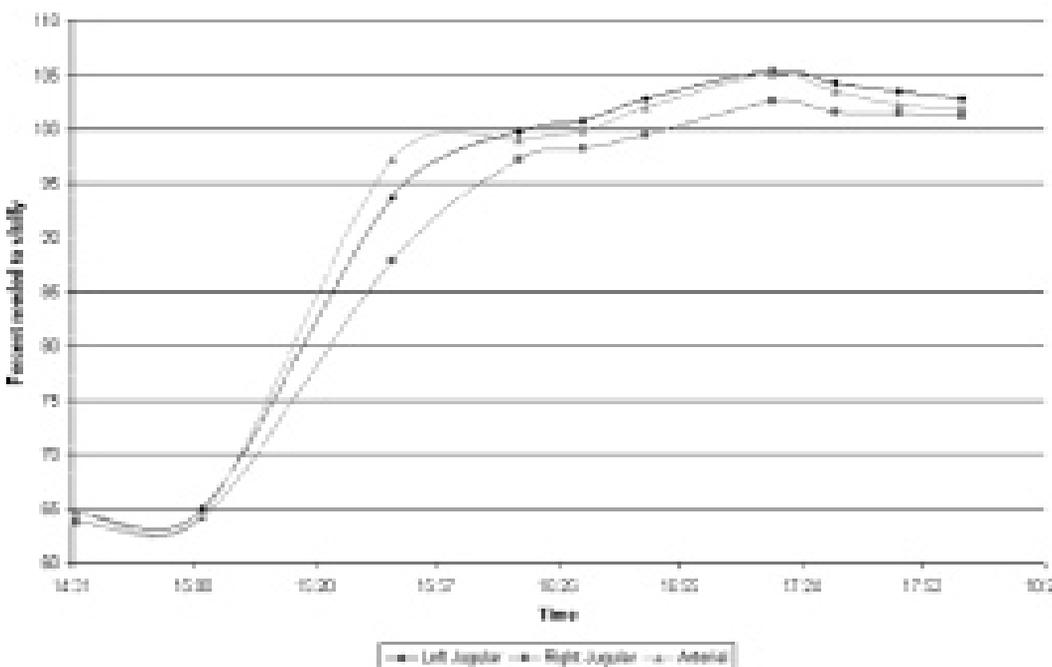
Once the patient was delivered to our door, it took about 20 minutes to complete the preparations for surgery. Though improved coordination has happened since this case, the operating table was lacking in ice; and the lifting straps were not ready when the patient arrived. Furthermore, a thermocouple was not placed because the transport team had failed to communicate the lack of temperature recording to the operating room personnel. Suction was also missing from the general preparations, and though it didn't compromise the quality of patient care in this case, its temporary absence made the surgeon's job slightly more difficult.

Cannulation of the major vessels and the cephalic isolation both went smoothly and were completed in 20 minutes. When the patient's head was transferred to the cephalon enclosure,

we learned his head was of a smaller diameter than most. The retaining halo screws in the enclosure were just barely long enough to secure the patient. We have since lengthened those screws to prevent a future need to improvise for smaller patients.

Small changes were also made to the perfusion circuit to protect the staff from infectious hazards. These changes became a standard part of the protocol after this case and included replacing the dump reservoir with a bladder. In adding the bladder, we quickly learned that the nature of the venous return system required that a vent be added to the circuit to prevent the bladder from filling with air. Once the

A-1563 Cryoprotection



blood washout had been started, the burr holes were created. In previous cases, we had drilled the holes during the isolation because detritus has a tendency to clog the perfusate filters. In this case, it was decided that beginning the washout with less delay was better for the patient than the couple of minutes required later to change a filter. There was a brief stall during the burr hole drilling because the internal mechanisms of the perforator seized. Once the components were properly lubricated, the device functioned properly.

Clots were observed exiting the vertebral arteries, primarily from the right side, immediately upon the initiation of perfusion. The number and size of the clots were more than we typically see, but they also stopped earlier than anticipated. In terms of fluid dynamics, this perfusion seemed almost ideal. High flow rates (at each cryoprotectant concentration level and temperature) were sustained throughout the procedure. Venous concentrations remained close to the arterial inputs at all points.

Substantial cerebral shrinkage was observed during the first part of the perfusion and swelling in the second part, to the point where the brain was nearing its original volume. Final equilibrium was obtained fairly rapidly. The changes inherent in this shrink/swell cycle were reflected in the combined reservoir volumes in the circuit.

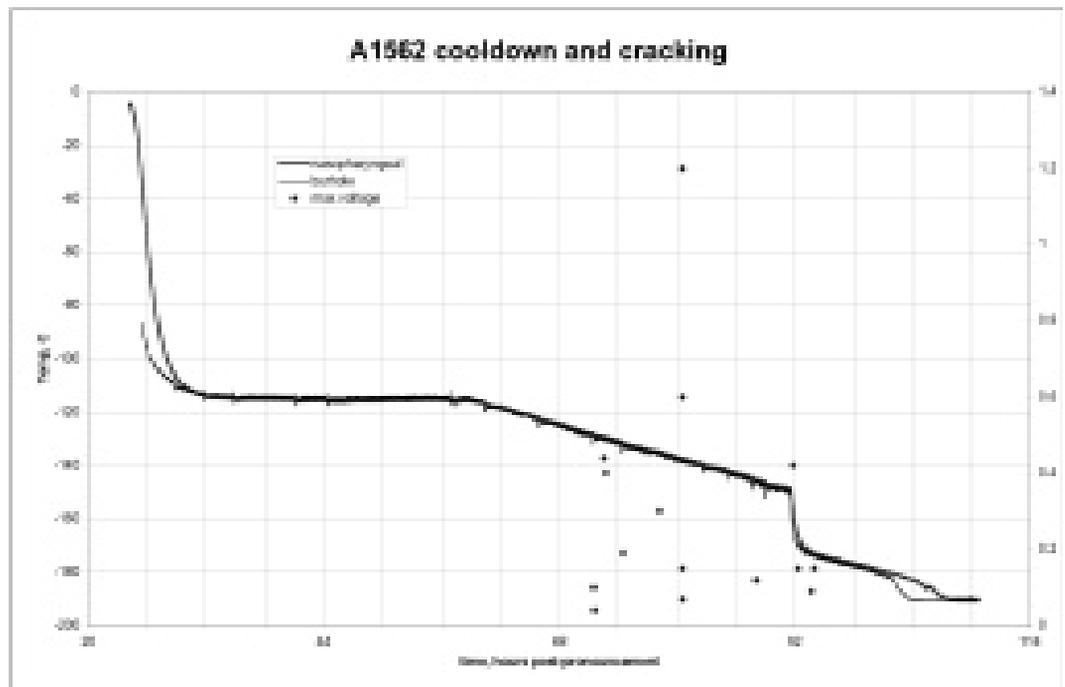
Target concentrations were reached bilaterally in the patient, with the left jugular achieving target concentrations first. Total perfusion time neared three and a half hours, with the left jugular having achieved equilibrated target concentration one hour and 45 minutes prior to the cessation of perfusion. The right jugular reached that point at one hour and 15 minutes prior to stop.

Despite less-than-ideal circumstances surrounding the transport, cryoprotection data indicates this was an excellent perfusion. This surprisingly good result continued throughout the cooling stage as well.

Cooling and Fracture Data

The patient entered the cooldown stage on April 28 at 04:46, following the initial prescribed cooling curve without incident, arriving at the final temperature of -196°C in approximately three and a half days. The rapidity of the overall cooling resulted because of a computer error.

On the date change from 30 April to 01 May, the cool-down controller added 24 hours to the ramp and proceeded to drop



the vapor temperature a full 24 degrees at once, plunging the internal dewar temperature from -148°C to -172°C in the space of a few minutes. The full effects of this plunge are unknown, but four cracking events occurred during the 24 degree interval, where the core temperature of the brain dropped over the course of several hours. Interestingly, there were no further fracturing events detected after those four. Also of interest is that the events did not occur until the patient's temperature had already dropped 6 degrees.

Seventeen fracture events were recorded in the temperature descent, with the first at -128.4°C and the last at -172.9°C. Four of the fracture events occurred in significantly less than a second at -136.2°C, a cascading cracking sequence the likes of which we have not seen before. In previous cases, there have rarely been two fracture events occurring within a second, but they have happened. Four events in such a short period of time is a new result.

A-1562: PATIENT PROFILE

- Confidential member
- 39-year old male
- AIDS patient for 20 years
- Residing in Florida
- Significant other an Alcor member
- Cause of death: cardiopulmonary arrest, lymphoma, AIDS

