

CryoPreservation Case Report:

The Cryopreservation of Patient A-2063

by Tanya Jones

The initial contact for this March 2004 case began at 12:15 (MST), with Hugh Hixon taking the emergency call. A non-member was in the hospital and dying. The gentleman was suffering from terminal cancer and had a subdural hematoma, the result of recent brain surgery. He was suffering from sepsis and pneumonia when Alcor received the call.

Though the patient was under heavy sedation when Alcor was contacted about his condition, he had previously communicated his desire to be cryopreserved to several witnesses, including his attorney. By the time Alcor was directly involved, the patient was in an agonal decline, his lungs were filled with fluid, and he had been intubated. As a result, he was unable to speak with us directly, and subsequent conversations were held between Alcor personnel, the immediate family and his attorney.

Because this individual had previously spoken with Alcor about arranging an anatomical gift, we had a file already in place. Financial arrangements had been made in advance, with Alcor

being made the partial beneficiary of an existing life insurance policy; but we were missing the legal paperwork. Paperwork was faxed to the hospital for execution by the patient's next of kin, all of whom had witnessed his statements about his choice for cryonics as his method for disposition.

Over the course of the next eight hours, the case proceeded administratively. In addition to faxing the contracts, we faxed a copy of our emergency stabilization instructions to the hospital staff. Alcor's Medical Advisor, Dr. Steve Harris and I spoke with the patient's physicians and arranged for the emergency instructions to pass through the hospital's approval process, whereby the administration of post-mortem medications was authorized and the appropriate orders were placed in the patient's medical chart. Though a transport team was expected to be on site, these precautions seemed sensible under the circumstances.

We placed our southern California team on alert, as they were closest to the patient's location. We notified our local and southern California Funeral Directors, and we contacted our local volunteers about the impending case. By 16:35, the operating room was prepared for the cryoprotection, the southern California team was preparing their deployment, and arrangements had been made for me to fly to California. Formal deployment was awaiting the signatures of the next of kin on an application and the provision of standby funding. By 21:00 (PST) that same evening, the minimum administrative elements were in place and the team was ready to drive to the hospital to begin on-site preparations.

We were expecting good cooperation from the hospital, and we received it. Shortly after the team arrived and the team leader met with the patient and his family, arrangements were made for prompt release and stabilization. Because the patient had been on life support for so long, it was anticipated that his condition would rapidly decline once life support was removed. As a result, we made certain that everything was ready before the patient was extubated.

In this case, preparations included having the physician on-hand for immediate pronouncement, ensuring ice and the preliminary medications (Heparin and Streptokinase) were all available for prompt administration, locating a suitable space for the application of the rest of the stabilization protocol, and speaking with hospital security to ensure a private escort out of the facility. Overall, these arrangements took about an hour to complete because the

Time	Event	Hours, post-legal death
12:15	Initial Alcor contact (MST)	-9.38
22:38	Cardiac arrest occurs (PST)	-0.17
22:39	Pronouncement of legal death	0
22:40	Medications started	0.17
22:41	Surface cooling started	0.33
22:41	Cardiopulmonary support started	0.33
23:35	Transport started	0.95
0:17	Medications complete	1.37
0:17	Cardiopulmonary support complete	1.37
7:04	Transport complete (MST)	9.56
9:00	Neuro washout started	11.37
9:46	Neuro cryoprotection started	11.47
10:40	Body washout started	12.17
10:49	Body cryoprotection started	12.33
15:05	Body cryoprotection complete	17.43
20:00	Neuro cryoprotection complete	22.37
20:17	Neuro cooling started	22.65
0:00	Body cooling started (from -32°C)	26.35
	Neuro cooling complete	140
	Body cooling complete	370

Table 1: Significant Events

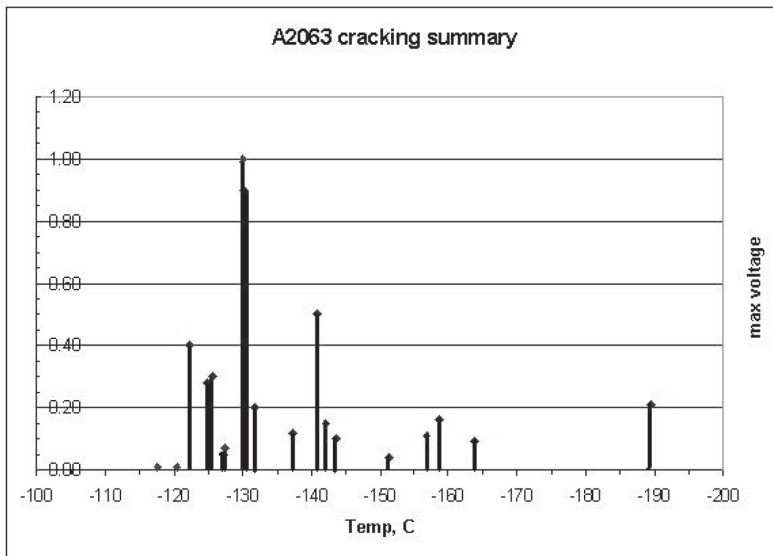


Figure 1: Acoustic Event Summary

patient's wishes were so well known to his caregivers and because communication with the hospital earlier in the day had gone smoothly.

Prior to being removed from life support, the patient's pulse was 118 beats per minute and his blood pressure was a low 75/55. His fingers were mottled and feet cold, he took few spontaneous breaths, and his arms bore bruises from old IV placements. He was surrounded by family and friends. At 22:28, he was extubated; by 22:30, he was off oxygen support; and his suctioning tube was removed. All IV drips were discontinued, and there was an immediate change in his vital statistics.

Stabilization and Transport

As expected, the patient's heart stopped beating quickly. From extubation to the cessation of heartbeat and breathing, eleven minutes passed. The patient's physician was on-hand and pronounced immediately. A short minute later, the hospital staff was administering the approved stabilization medications, packing the patient's head in ice, and beginning cardiopulmonary support to circulate the first batch of meds.

Bedside cardiopulmonary support continued for five minutes, and then the patient was turned over to Alcor personnel. We transferred to a vacant patient room on an empty floor below and were allowed to continue the stabilization there, where it wouldn't disturb any other patients.

Chest compressions and the introduction of the remaining stabilization medications were initiated at 23:00. Our first temperature reading was taken five minutes later and was 35.4°C. Seventeen minutes passed, and all but one of the large volume medications had been administered in full and circulated. Security was contacted to provide us with an escort to the loading dock, and some of the team members began cleaning the space.

By 23:30, the patient was being loaded into the southern California vehicle; and the team split up, with two team members taking the patient and the used portion of the transport kit to Alcor and the rest heading home. At 23:59, transport was paused to administer the final large volume medication, with cardiopulmonary support being continued until 00:10. More ice was added to the bath, and the patient's temperature had dropped to 31.6°C. At this point, it was discovered that blood had backed into the mannitol bag, because the IV line stopcock hadn't been closed. It was then properly secured, and the contents of the bag held, in case a blood sample could later be extracted. With the stop for the final medication and a single stop for gas, the drive to Scottsdale took about seven hours; and the patient was transferred to operating room personnel, without incident, at 07:04.

Cryoprotection

Taking five minutes to unload, the patient was on the operating table by 07:10. By this time, his temperature had dropped to 10.4°C. Burr hole drilling was started within five minutes, after shaving the head and disinfecting the scalp, and was completed by 07:29.

Hours, post-legal death	Temp, Celsius	max voltage
2.86	-117.70	0.01
65.87	-120.50	0.01
67.98	-122.20	0.40
71.31	-124.90	0.28
72.23	-125.60	0.30
73.21	-127.20	0.05
73.50	-127.40	0.07
75.78	-130.00	1.00
75.89	-130.30	0.90
77.58	-131.80	0.20
81.32	-137.36	0.12
84.32	-140.90	0.50
84.32	-140.90	0.17
84.26	-142.20	0.15
87.26	-143.60	0.10
95.60	-151.30	0.04
101.49	-156.70	0.11
102.98	-158.70	0.16
108.44	-163.80	0.09
136.77	-189.50	0.21

Figure 2: Acoustic Cracking Events

This patient had chosen the neuro-vitrification with whole-body cryoprotection option for preservation, which involved two separate surgeries, the first requiring cannulation of the arteries and veins in the neck and neuro-separation and the second requiring cannulation of femoral artery and veins. B2C was used as the cryoprotectant for the brain and glycerol was used for the body.

Preliminary carotid incisions were made on the left side at 07:38. While the surgery continued, the cryoprotective perfusion circuits were still being prepared; the last small bubbles in the neuro circuit were removed at 07:46. Six minutes later, the surgeons completed dissecting the carotid sheath and were isolating the artery, a process that was completed by 07:58. Incision on the right side began at 08:03; and isolation on this side was completed by 08:23. Subsequent cannulation of all vessels required an additional fifteen minutes.

Neuro-perfusion was begun at 09:00, after the head was removed and placed inside the cephalon enclosure. We saw good flow from the left side, but the right jugular showed little venous return. Flow eventually picked up somewhat, but the reason for the obstruction was not determined. Less than twenty minutes later, we noted some swelling of the brain. We attempted to moderate the swelling by slowing perfusion and allowing more time for the cryoprotectant to equilibrate across the hemispheres.

The left hemisphere reached terminal concentrations at 15:00, but the right hemisphere had only obtained 59.4% of the concentration needed to vitrify. We continued the neuro perfusion for another five hours before stopping because of toxicity concerns, lowered uptake curves, and staff exhaustion. Final uptake concentration on the left jugular side was 117% of the concentration necessary to vitrify, and the concentration on the

right had climbed to 74%. This was the longest neuro-perfusion we've ever done.

At 09:19, preparation for surgery on the trunk was started. Femoral cannulation was used. By 10:38, cannulation was complete and the circuit was ready. Washout on the trunk began two minutes later. Once the washout began, time was taken to clamp off the vessels at the stump of the neck. On whole, this worked well to contain the seepage of cryoprotectant. Perfusion on the trunk went better than that of the head, and a step-wise ramp was used during the introduction of the cryoprotectant. Perfusion of the trunk was completed at 15:05 after reaching the terminal concentration of 8 Molar glycerol.

Cooldown and Transfer

Temperature descents occurred at the standard rate of 1°C per hour.

The head and the trunk were cooled separately, largely because the trunk would require more time to cool due to it being of significantly more mass. The trunk was cooled manually until the automated system was done with the neuro cooldown. Transfer to the automated system occurred while the patient was at -32°C. The cooling to dry ice temperatures for the trunk was done using the Silicone Oil system, which is no longer in use today, having been replaced with a liquid nitrogen vapor cooling system.

We saw twenty acoustic events during the neuro cooling phase. The first registered at 62.86 hours after pronouncement at -117.7°C. Typical though this cracking temperature was, it was considerably above the reported glass transition temperature of the B2C perfusate (-124°C), which is where such acoustic events would be expected to occur. On the whole, the number of acoustic events was typical, but a more uncharacteristic observation is that the first several cracks were quite small. The most energetic acoustic events were at 1.0 and 0.9 volts, high for B2C but low compared to larger glycerol cracks, which register at amplitudes of greater than 3V.

Our acoustic monitoring system crashed during the neuro temperature interval of 191.3-191.4°C. During this time, the system was still taking note of acoustic events, but it lost the date and time associations. There was only one event recorded during this interval, but it registered noise across all four channels, indicating it was actual noise and not the patient fracturing.

Both transfers to the maintenance dewars for long-term care proceeded without incident.

A-2063 Neuro Cooling Data (Patient Only)

