

Cryopreservation Case Summary:

The Cryopreservation of Patient A-2024

by Tanya Jones, Director of Technical Operations

This patient contacted Alcor in September 2002, after reading an article on Alcor in the *Atlanta Journal*. He was already suffering from lung cancer and diabetes at the time of his application for membership the following month. Though his diabetes was under control at the time of his application, he was receiving treatment for lung cancer that included chemotherapy and medications. His membership was approved on June 6, 2003.

In October 2003, the member traveled from his home in Georgia to attend an Alcor training session held in Mayer, AZ. He learned about the stabilization protocol, the logistical arrangements that we prefer be made in advance of a case, and met some of the people who would provide for his care. Armed with the parameters of a successful cryopreservation stabilization and transport, he then went home and ensured that his family was informed of his wishes; that his personal physician would be supportive; and started corresponding with Alcor, looking for more detailed information than his brief training was able to provide. As his questions were answered, the member took care to use the information to ensure his preparations were as thorough as possible.

Preliminary Standby

When a preliminary standby was launched on March 21, 2005, the patient was in relatively good condition for a 65-year old man with metastatic lung cancer. The standby was launched because he had an episode resembling a stroke that resulted in a brief hospitalization. He, his family, and Alcor personnel were all concerned about the risks of sudden death and of not having an Alcor team on site, and we felt an assessment was warranted. Five team members were deployed: Bill Voice and Tanya Jones traveled from Alcor, one from Laughlin, and two from Florida. In his first case as Transport Coordinator, Bill Voice traveled first to carry out the assessment; and it was his opinion that the team would be needed soon. Our patient was anxious and did not relax until the rest of the team arrived and could reassure him that the equipment was ready for use.

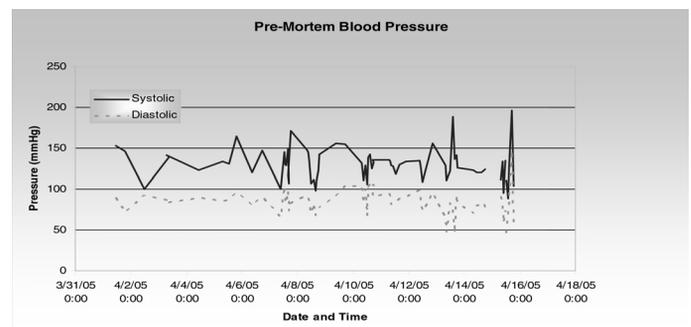
Arrangements were made for one of the Florida paramedics to carry their transport kit as baggage on her flight from Fort Lauderdale. After she boarded the plane, she was informed that there would be a delay in departure. Passengers were given the opportunity to step off the plane; she took this opportunity to use the terminal restroom and subsequently missed the flight. The Florida Coordinator made arrangements for the baggage to be

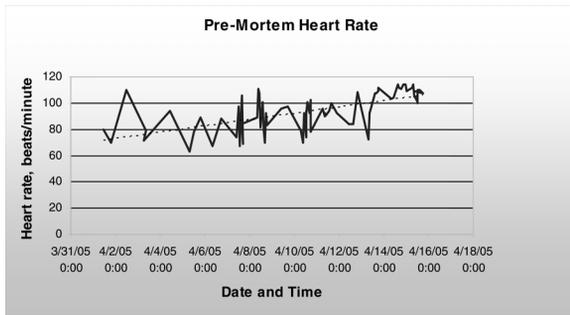
picked up by Bill and Tanya upon their arrival at the Atlanta airport. Though there was no trouble in the custody transfer of the baggage, one of the necessary kit components (ATP Support Kit) was missing. We had the ATP Support Kit delivered late the next day via Federal Express.

The patient was being cared for on the main floor of a three-story townhouse, and the team set up their equipment in the lower floor library. Preparations were made that included drawing up the medications; assembling the portable ice bath; purchasing ice; and setting up a bookshelf to hold airway supplies, temperature probes and loggers, and safety supplies. The team met with caregivers, the family and funeral directors to ensure that logistics were clear to all involved.

The on-site caregiver was not authorized to pronounce legal death, so we made alternate arrangements. A hospice nurse (and family friend) who lived nearby would be called by the caregiver on duty when the patient's heart stopped, and she would come to the house immediately to pronounce. Once pronouncement occurred, the funeral directors would be called to transport the patient from the home to the mortuary for blood washout. Though their facility was close to the home, the funeral director would only guarantee a pick-up within one hour. Our calculations indicated that this would be nearly ideal for our implementation of the preliminary portion of the stabilization protocol (surface cooling, medications, and cardiopulmonary support). A funeral director would do the femoral cut downs, and our team would be responsible for the perfusion.

After four days, it was clear the member was not in imminent danger; and we made arrangements to conclude the standby and return home. Because his remaining time was expected to be fairly short, we chose to leave the equipment and supplies in place. Before leaving, Bill and I counseled the family on agonal signs and general indications that clinical death was approaching. Starting on April 1, 2005, the family and caregivers began tracking





vitals, medications, food, fluids, urine output and bowel movements, and bathing in separate notebooks. As a result, we have an unprecedented amount of pre-mortem information for a home situation.

We also spoke to the funeral directors about a sudden death situation and what would be required of them if Alcor personnel were not on-hand at the moment of pronouncement. We left the ATP and perfusate in their care for the duration.

Second Standby Deployment

During our absence from the state, we kept in close contact with the family and caregivers. The decision to return to Georgia was made on April 14, 2005, with the primary indicators being a change in the color of the patient's urine from tea-like to coffee, indicating kidney failure. Our patient was becoming tachycardic, and his oxygen saturation levels had dropped to 86 percent. Bill and I went out first in order to once again assess the situation. We put the other members of the transport team on alert.

After our arrival at 7:00 PM on April 15, 2005, a patient assessment yielded these results:

- Blood pressure: 105/78
- Pulse: 107
- Pulse oximetry: 87%
- Respirations: 38 / minute
- Temp: 100.7°F (axillary)
- Capillary refill: 2 seconds
- Lung sounds: crackling in all quadrants
- Physical: Weak distal pulse, no response to verbal commands, negative reflex in feet, no major discoloration or mottling, feet cool, hands warm and dry.

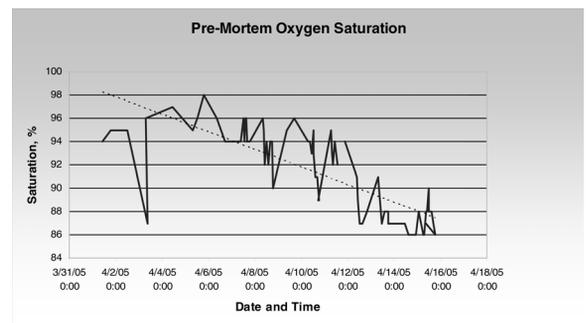
Bill and I went downstairs after spending some time with the family member and caregiver to ensure that our equipment was still ready. We checked the equipment placement, availability of ice, and coordinated the arrival of the remaining team members. Once our Florida paramedic arrived shortly after midnight, he and I began drawing the medications for administration.

Stabilization

At about 3:15 AM (EST) on April 16, 2005, the caregiver came downstairs to alert us to an unspecified change in the

patient's condition. This was a timely alert, as by the time I arrived upstairs at 3:21, the patient's heart had stopped. His temperature (right tympanic) at the time was 101.9°F (38.83°C). The hospice nurse was called at 3:22 to pronounce, and I went downstairs to prepare the surface cooling and medications while the family waited for the nurse to arrive.

By 3:38, the patient had been pronounced, removed from the bed, and transferred to the portable ice bath downstairs. He was immediately surrounded with ice. Following the initiation of surface cooling, I placed a nasopharyngeal temperature probe (one connected to the new logging device found by Steve Van Sickle), verified its operation, and completed the medication preparation. Bill secured a Combi-tube airway (endotracheal placement) at 3:40, and the Florida paramedic began attempting to gain IV access. Numerous attempts were made by both of them to gain access to the circulatory system, using bilateral



antibiotics and wrists, the sub-clavian, and the external jugular. All failed; though at least two sticks flashed, they were unable to confirm proper placement. Ventilation and manual chest compressions were started (using the Ambu-Cardio pump), both beginning at 3:42. After a couple of minutes, good gas exchange was confirmed with the endtidal CO₂ detector, which registered at less than five percent.

Maalox was administered through the nasogastric tube at 4:16; epinephrine was administered through the endotracheal tube at 4:17. His temperature at the time was 32.9°C. At 4:27, the patient's temperature was 32.7°C. (These temperatures were manually recorded, using the DualLogR display and a second nasopharyngeal temperature probe.)

Washout

At 4:35, the funeral director arrived to transport the patient to the mortuary; compressions and ventilations were stopped at that time. By 4:42, the patient was loaded in the vehicle; and at 4:46, we arrived at the mortuary. By 4:50, the patient was unloaded; his temperature was 30.2°C. By 4:54, he was on the prep table and re-packed in ice. By 5:05, the funeral director was starting the right femoral cut down. A 14-french arterial cannula was placed. By this time, the ATP setup was complete, and circuit priming with MHP-2 washout solution had begun. At this time,

we also noted that the temperature probe had dislodged during transit; and it was replaced.

A 24-french venous cannula was placed on the right side by 5:10, and the patient's temperature was noted to be 27.4°C. By 5:20, both cut downs were complete, but we discovered that the arterial cannula did not fit the tubing connectors for perfusion. A brief search of the kit did not reveal any reducers that would work, so the funeral director was told to replace the arterial cannula with one that would fit. What he did to resolve the lack of connection was thread a venous cannula through the arterial one; and the venous cannula was then connected to the circuit. The connection should not have been completed this way, but the funeral director did not know that; and the team was unfortunately occupied with the perfusion preparation and did not notice until later troubleshooting was in progress.

De-bubbling of the circuit was started at 5:40. The washout itself was started at 5:50, and the first burst of blood escaping the patient revealed a large, fuzzy clot, an indication of the lack of medication protocol administration. The patient's temperature was 24.5°C at the start of the washout. A venous sample was taken at 5:55; the pump speed was 3.58 liters per minute.

At 6:10, we noticed bubbles in the circuit moving toward the patient's arterial intake and stopped perfusion. I isolated the source as the temperature probe port on the arterial side, and the thermocouple was removed from the port. This proved to be only one source of bubbles, of two, because there were still bubbles. After 15 minutes of investigation and tracing the circuit, I noticed the funeral director's improvisation on the arterial cannula. This was the second source of bubbles, and it was quickly fixed by having the funeral director remove the nested cannula and replace just the venous. We do not know if this introduced emboli into the patient. By 6:30, we were back on bypass.

Fixing the arterial cannula was the final problem with the washout, and by 6:35, the patient's temperature had fallen to 16.6°C. The patient looked good; and we observed his fingers and toes losing color, more clots were pushed from his circulatory system (all small), and his temperature was finally dropping at an acceptable pace.

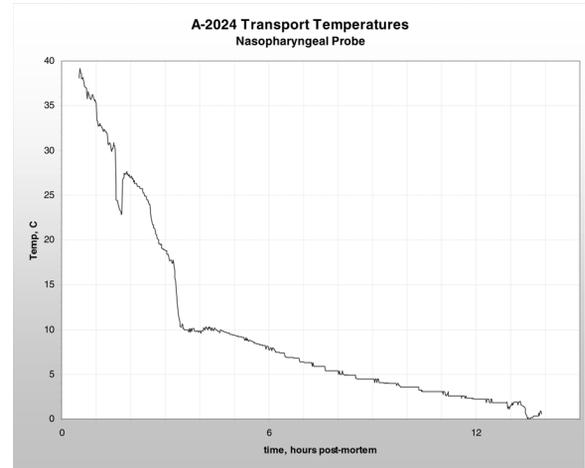
At 6:45, we began recirculation and observed signs of abdominal bleeding, despite the administration of Maalox. The patient's temperature was 10.0°C. The right side was washing out well, but the left side was notably darker in its effluent. I massaged around the incision, as our Scottsdale funeral director once recommended, and a large clot shot out. After that, the venous side cleared nicely. Perfusion was stopped at 6:50 (with the patient's temperature still at 10.0°C) due to abdominal distention and loss of perfusate volume. Transport samples were placed in the centrifuge upon delivery to Alcor and indicated hemodilution at three percent of normal.

By 7:30, the mortuary was cleaned up, the patient covered in ice, and we were preparing for shipment to Phoenix. Good cooperation was had from every person involved in this stabilization and transport. The time of pronouncement proved ideal for getting an early flight to Arizona, and we had no trouble

obtaining two seats on the plane with the patient. We landed at the Phoenix Sky Harbor airport at 12:21 (MST).

Cryoprotection

The patient was picked up by our local funeral director and delivered to Alcor at 13:12, less than 13 hours after pronouncement. Within six minutes, he was transferred to the operating table and packed in ice. Prepping of the burr hole sites



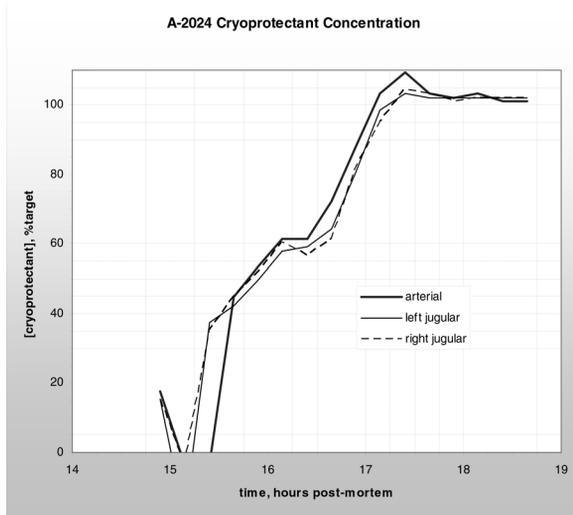
began at 13:23, with the first incision occurring at 13:27. Our new perforator was used, and the burr holes were both completed within four minutes.

As this was a neuro patient, surgery to access the neck vessels began next. The left carotid was isolated by 13:49 and the right by 13:56. Cephalic isolation was done, and the patient was transferred to the vitrification enclosure and secured for perfusion by 14:15. He was almost too large for the stabilizing ring in the enclosure, and we should consider alternate ways to accommodate larger patients, since it seems likely we will eventually get one who does not fit. At this time, the patient's temperature was 3.2°C.

Cannulation was completed within nine minutes, and perfusion was started at 14:30. Good flow rates and pressures were achieved immediately, and the effluent was noted to be clear. Within fifteen minutes, we observed retraction of the brain, indicating washout solution uptake, though slightly more in the left hemisphere than in the right. Removal of the field washout solution was completed by 14:47, and the cryoprotective ramp started moments later.

Lateral symmetry was observed during the initial portions of the cryoprotective perfusion, as measured by pressure and verified through external observation of brain retraction. Jugular flow was unusually good. During the latter part of the perfusion, the left hemisphere of the brain and the left side of the face both swelled slightly. The right side did not. Minimal foaming was seen in the circuit during perfusion, and samples were taken of the foam for analysis.

Cryoprotective perfusion continued until 19:02, at which



point the patient's effluent had remained above the target concentration of cryoprotectant for more than an hour. Perfusion pressures and flow rates were consistently high, and the correlation between arterial and venous readings on all parameters (mainly, pressure, flow and refractive readings) was good. By 19:15, the patient had been disconnected from the circuit and removed from the enclosure for transfer to the cool down area.

Cooling

Temperature probes were placed in the nasopharyngeal cavity and in both burr holes; we also monitored gas and ambient temperatures directly. Because this was a B2C perfusion, first-stage cool down was a plunge to -110°C and was started at 19:38. Second stage cooling was carried out at the rate of $1^{\circ}\text{C}/\text{hour}$ from -110° to -200°C , beginning at 10:06 on April 14.

Seven fracture events were recorded, with the first occurring at -125.6°C and the last at -135.4°C . This case was significant in that the number of acoustic events recorded was our second-lowest (Five was the lowest number recorded. A-2020, Dec 2003) and in that the temperature range across which the events occurred was unusually small.

Casting a shadow of doubt on this data, we were plagued with electrical noise of an unknown origin on this case, affecting both the antenna and the acoustic leads. The computer also crashed several times. Because we were monitoring the system for other reasons, we still had full coverage of the data.

On May 5, 2005, the patient was transferred to one of the Bigfoot dewars for long-term patient care.

Conclusion

We had exceptional support from the family and caregivers; the patient himself went out of his way to become more familiar with the technical aspects of a cryopreservation procedure. Logistics were well-coordinated in advance, with the familiarity of the healthcare providers and family with cryonics,

cooperation of the nearby funeral director, stabilization equipment being on-site and still ready when pronouncement occurred, and the general skill level of the transport team members. For the first application of our Comprehensive Member Standby program, we found that taking the time to deploy a team a few weeks before the patient needed our services was an invaluable preparatory tool.

The inability to obtain venous access during stabilization, even with experienced paramedics performing the sticks, is still a source of concern for us. We may have since found a solution to this problem and are investigating the use of a new intraosseous needle system that has a high success rate with under-trained personnel gaining IV access. The success rate of this new device is 97 percent, with contraindications being obesity and bone cancer; and it is able to maintain the flow rates needed for administration of even the large-volume stabilization medications. We hope that lack of IV access may no longer be a problem for our field teams, once the new equipment is deployed and personnel are trained in its use.

For this case, the patient benefited from the proximity of a cooperating funeral home and the speed with which the washout commenced. Later cryoprotection proceeded without incident, and good perfusion and bi-lateral cryoprotectant uptake were sustained throughout the entire procedure. Cooling was prompt; and the number of fracture events detected was low, covering an unusually small temperature range.

Communication between the family, medical personnel and Alcor was sustained between team deployments; and the transport team arrived in time to perform the stabilization, despite the difficulties of a remote patient assessment. Communication was critical in ensuring that the team was deployed in a timely manner. This was the first case for our new Transport Coordinator, and he responded very well to the situation. Bill was largely responsible for the quality of pre-mortem communication, as he kept in close contact with the family.

On the procedural side, we implemented our first cross-regional team exercise, in that we flew in transport personnel from one of the more remote, less-populated regions to participate in the case. We intend to continue this practice, to ensure that trained and experienced transport personnel exist in all regions.

