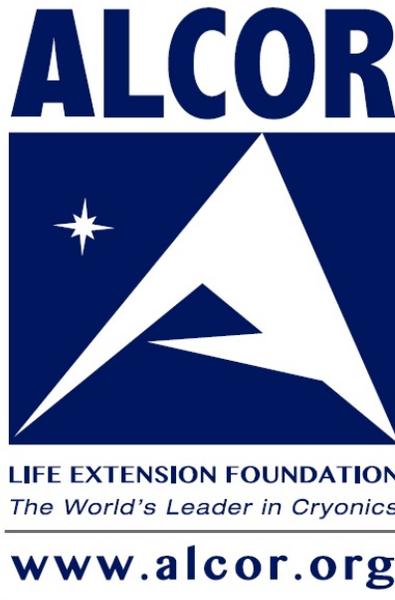


Alcor A-3360

Case Report



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1. Summary

Information was derived from multiple sources and was all converted to Mountain Standard Time (MST). For de-identification, dates are not shown. T-0 represents the date of pronouncement of legal death, T-X represents occurrences on dates before T-0, and T+X represents occurrences on dates following T-0.

A-3360 was an 87-year-old male with whole-body cryopreservation arrangements made at the last moment by his family, but not completed until after legal death. He had experienced a cardiac arrest and was pronounced legally deceased in California at 04:00 hrs in June of 2020 on T-0 days. Alcor was alerted by the family at 15:36 hrs. Since his family had not yet finalized legal and financial arrangements, this would be a cryopreservation without cryoprotection (a straight freeze procedure).

The patient was cooled in California with water ice first and then with dry ice on T+1 days, before being transported to Alcor for cryogenic cooldown from -80°C to -196°C which was initiated at 10:11 hrs on T+7 days and terminated at 18:46 hrs on T+12 days. The patient was transferred to long-term maintenance at liquid nitrogen temperature at 14:15 hrs on T+15 days.

2. Patient Assessment and Deployment

Information was derived from multiple sources and was all converted to Mountain Standard Time (MST).

T-0 days

Alcor's Medical Response Director (MRD) notified Alcor personnel on the internal communication system (ICS) at 15:36 hrs that there was a potential whole-body, third-party signup located in California. The potential member had suffered a cardiac arrest in hospital and been pronounced legally deceased at 04:00 hrs. It is assumed, although we do not have specific details from the hospital, that pronouncement followed cardiac arrest almost immediately. The Alcor Board of Directors had not yet approved this membership because the legal documentation and funding had not yet been received, but efforts were being made to approve the membership as quickly as possible.

The potential member had a pacemaker, had a myocardial infarct five years earlier, and had a recent bile duct infection that caused him to go into kidney and heart failure. The cause of death on the death certificate was heart failure. He had had two COVID-19 negative tests, the most recent one had been done one week earlier.

A funeral director in California was contracted to pick up the patient at the hospital and transport him to the funeral home. At approximately 16:08 hrs the funeral director covered the patient with water ice per recommendations from Alcor's Scientific Advisor. Water ice, rather than dry ice, was recommended because it would be high-risk to initially pack the patient in dry ice due to the risk of rewarming since Alcor was not yet managing the case (see the Discussion section for more details). Because the membership had not yet been finalized, and after further consultation

with Alcor's technical staff and Scientific Advisor, it was decided that this would need to be a cryopreservation without cryoprotection (straight freeze), and a dry ice shipper would be built and used to transport the patient to Alcor.

Alcor's Deployment Committee dispatched one of its strategic partners, International Cryomedicine Experts (ICE), to send one of their paramedics to California to retrieve the patient and manage the initial cooldown and transport to Alcor. The earliest flight to California was the next morning. Alcor instructed ICE to act in an advisory capacity only until Alcor had received the legal documents and the funding to make this case possible.

T+1 days

The legal paperwork had been signed at 08:10 hrs making it possible to authorize ICE to begin cooling with dry ice upon arrival in California. Authorization for transport of the patient would have to wait until the funding was received at Alcor.

500 lbs. of dry ice were procured at 08:56 hrs. The ICE paramedic arrived at the funeral home at 12:15 hrs and assisted the funeral director with removing the water ice and then covering the patient with dry ice. A nasopharyngeal temperature (NPT) probe was placed in one of the patient's nares at 12:25 hrs. The initial temperature reading was 20°C. By 12:46 hrs the patient had been fully covered with approximately 350 lbs. of dry ice and the NPT reading was 16.0°C.

A second member of the ICE team arrived at the funeral home at 14:00 hrs. The ICE team discussed the details about transporting the patient to Scottsdale with the funeral director. An additional 50 lbs. of dry ice were added to the patient at 17:04 hrs. The NPT reading was 13.8°C.

T+2 days

The ICE paramedic checked the patient at 07:32 hrs. There had been minimal dry ice sublimation. An additional 50 lbs. of dry ice were added. The patient's NPT reading was -10.0°C. At 09:02 hrs the NPT reading was -11.8°C.

ICE personnel purchased the supplies needed to assemble the dry ice shipper. The Zeigler case and the air tray that had been ordered arrived at the funeral home. The patient was moved into the newly assembled dry ice shipper at 12:54 hrs. The patient's NPT reading was -18.0°C (see the Discussion section below regarding the temperature readings).

At 14:00 hrs Alcor's MRD spoke with the ICE paramedic about his availability for another Alcor case (A-1404) underway. It was decided that the ICE EMT would stay with the California patient and the paramedic would fly to Alcor to be available in the operating room (OR) to assist the surgeon when patient A-1404 arrived. An additional 200 lbs. of dry ice were purchased to be available in California. At 08:39 hrs additional dry ice was added to the shipper. The patient's NPT reading was -32.0°C.

3. Transport

T+3

The patient departed the funeral home at 08:50 hrs en route for the airport to be air transported to Alcor by a commercial carrier. The patient was accepted by the cargo department at 11:03 hrs. The total weight of the shipper was 598 lbs. The patient arrived at Alcor at 18:06 hrs. The data logger reading for the NPT was -44.3°C . Per Alcor staff who inspected the dry ice shipper, it had been assembled to the specifications.

4. Cooling to Liquid Nitrogen Temperature

The patient arrived at Alcor at 18:06 hrs during the cryoprotection procedure in the OR at Alcor for patient A-1404. Upon completion of the procedure for A-1404, patient A-3360 was processed. This did not compromise patient A-3360 since he was still cooling to dry ice temperature (see the Discussion section).

T+7 days

The appropriate computer program was used to initiate cryogenic cooldown at 10:11 hrs, plunging to -110°C and descending thereafter at $-1^{\circ}\text{C}/\text{hour}$ to liquid nitrogen (LN_2) temperature. At 18:46 hrs on T+12 days, an uneventful cooldown was terminated. The patient was transferred to long-term maintenance at LN_2 temperature on T+15 days.

5. Timeline and Time Summaries

Timeline

T-0 days

04:00 Estimated time of cardiac arrest and pronouncement
15:36 Notification of legal death
16:08 Funeral director covered patient with water ice

T+1 days

12:15 Start of dry ice cooling (dry ice placed on the patient)

T+3 days

11:03 Patient shipped from the remote location
18:06 Arrival of the patient at Alcor (86 hrs after cardiac arrest)

T+7 days

10:11 Start of cryogenic cooldown from -79°C to -196°C

T+12 days

18:46 End of cooldown from -79°C to -196°C

June, T+15 days

14:15 Transfer of patient to long-term maintenance at LN₂ temperature

Time Summaries

hrs: mins

86:06 From pronouncement of legal death to patient arrival at Alcor: 04:00 hrs on T-0 days to 18:06 hrs on T+3 days

174:11 From pronouncement of legal death to start of cooldown: 04:00 hrs on T-0 to 10:11 hrs on T+7 days

64:05 From arrival at Alcor to the start of cooldown: 18:06 hrs on T+3 days to 10:11 hrs on T+7 days

6. Discussion

In 2019 Alcor had had a last-minute sign-up and cryopreservation without cryoprotection (straight-freeze) case (A-3224), where the patient was in a mortuary cooler at 12.2°C for seven days until he was moved to the Alcor dry ice shipper. That delay resulted primarily from the time it took for Alcor to receive the legal documentation and funding from the family. It was decided that for future cases of that type, Alcor would recommend to the family that they put the patient on dry ice as soon as possible to prevent ischemic and structural damage from a long period of time at room temperature.

With patient A-3360, that decision was revised after discussions with Alcor's Scientific Advisor and technical personnel. Putting the patient on dry ice might be the best option for the patient when it will be several days before the Alcor Board can approve the membership. In cases where it will be less than 24 hours, it might be better for the patient to be covered with water ice first, and as soon as possible. The reasons for this are, first, if the patient is covered with dry ice by any party other than Alcor and Alcor is not yet managing the cooldown and temperature maintenance, there is a risk the dry ice is allowed to sublime away, causing a harmful freeze and thaw cycle. Second, if the patient is not laid out straight and dry ice is applied, the patient may not be straight enough to be put into a Zeigler case. For these two reasons, the trade-off between the use of water ice and dry ice must be decided based on individual circumstances.

There was evidence to suggest that the temperature readings were not accurate. The patient was covered with dry ice on T+1 days, after which the nasopharyngeal temperature (NPT) reading was 16°C. Patients are assumed to be at dry ice temperature (-80°C) within 24 hours but on T+2 days, this patient's NPT reading was only -18°C before being air transported to Alcor. When the patient arrived at Alcor on T+3 days, the NPT reading was only -44.3°C on the data logger. On T+7 days, before the patient was transferred to the cooldown dewar, the temperature read about -75°C. The NPT probe only started reading a reasonable temperature after several days when it should have read about -80°C within approximately 24 hours of the patient having been covered with dry ice.

This is why these temperature readings were called into question. Because this was a post-mortem, third party signup, no debrief meeting was held and, therefore, no corrective action was identified. On the case directly following this, however, there were no issues with transport temperature data. Additional data loggers were added to the SST kits, but it is not known if there will be issues until arrival at Alcor. A new device is under development at Alcor, the Universal Data Logger (UDL), that should eliminate the frequent and recurring problems with the commercially available data loggers.

There were no other issues with the cooldown. The patient was without dry ice for only two minutes before the cooldown commenced.

7. Graphs

