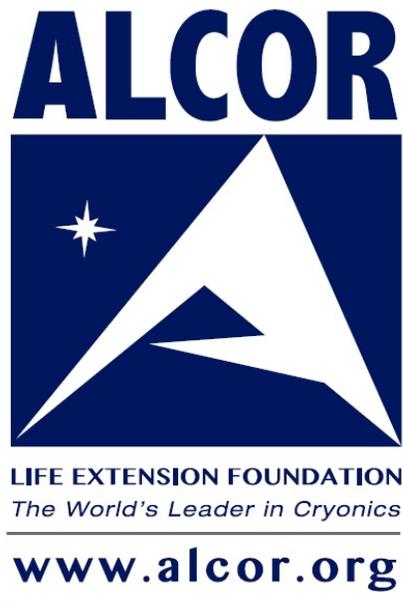


Alcor A-2037

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 cardiac arrest (if more than a few moments before pronouncement) or pronouncement of legal death, T-X represents occurrences on dates before T-0, and T+X represents occurrences on dates following T-0.

A-2037 was a 78-year-old male with neuro cryopreservation arrangements. The cause of death per the death certificate was environmental heat exposure complicating hypertensive cardiovascular disease with hyperlipidemia being a contributing factor. The patient was pronounced legally deceased in Arizona at 17:37 hrs on T-0 days in July of 2020.

As Alcor was not notified and did not take possession of the patient until T+10 days, this was a cryopreservation without cryoprotection (straight freeze). The patient arrived at Alcor on T+10 days and the cryogenic cooldown was initiated at 15:27 hrs and was terminated on T+19 days at 22:10 hrs. CT scans were made of the patient's brain at liquid nitrogen temperature on T+46 days at 12:30 hrs. The patient was transferred to long-term maintenance at liquid nitrogen temperature on T+94 days at 15:38 hrs.

2. Transport

T-0 days

The patient had been found deceased in his home in Arizona. The length of time between cardiac arrest and pronouncement of legal death was not known or estimated by the Medical Examiner (ME) at the time of pronouncement which was 17:37 hrs (see the Discussion section). Since the cause of death per the death certificate was environmental heat exposure complicating hypertensive cardiovascular disease with hyperlipidemia being a contributing factor, it is assumed that the temperature in the patient's home was not highly cooled with air conditioning, but there is no verification available. Although the length of time between cardiac arrest and pronouncement of legal death cannot be determined beyond saying an unknown number of days.

The patient had been sent by the coroner to a state funeral home after failing to locate any next of kin. The funeral home did have the patient under refrigeration, but the exact temperature in this case is not available.

T+10 days

The member had no information such as an ID bracelet or wallet card to identify him as an Alcor member. He was sent to a state funeral home while the office of the ME searched for any family or someone to take possession of his remains. Through that process, they contacted his financial advisor, who was aware of the member's cryopreservation arrangements and contacted Alcor's emergency answering service with notification of his situation at 11:07 hrs.

Alcor staff retrieved the patient from the state funeral home at approximately 14:00 hrs. The cephalic isolation was started at approximately 15:05 hrs shortly after the patient arrived at Alcor. The patient's temperature was not measured during cooling because of simplified procedures to mitigate COVID-19 infection risks.

3. Cooling to Liquid Nitrogen Temperature

The appropriate computer program was used to initiate cryogenic cooldown at 15:27 hrs, plunging to -20°C , holding for eight hours, and descending thereafter at $-1^{\circ}\text{C}/\text{hour}$ to liquid nitrogen (LN_2) temperature.

T+11 days

On at 00:04 hrs, the cooldown computer was found to stopped functioning. It was a new system and no alarm had sounded. The temperature in the nitrogen gas was 6.8°C . From the cooldown data, the computer malfunction had happened at 20:30 hrs, about 5 hours of run time. The cooldown program was restarted with the older cooldown system at 00:12 hrs. ~~on T+12 days.~~

Cooldown was transferred to the older system at 00:31 hrs and the computer was checked several times a day until liquid nitrogen temperature (LN_2) was reached. The end of the ice formation phase was reached at 08:30 hrs and the cooldown computer was then programmed to plunge from -20°C at $-1^{\circ}\text{C}/\text{hour}$ to liquid nitrogen temperature.

There were no further problems. The cooldown was terminated at 22:10 hrs on T+19 days. CT scans were obtained of the cephalon at LN_2 temperature at 12:30 hrs on T+46 days, and the patient was transferred to long-term maintenance at LN_2 temperature at 15:38 hrs on T+94 days.

4. Timeline and Time Summaries

Timeline

T-0 days

17:37 Time of pronouncement of legal death

T+10 days

11:07 Notification of legal death (Arizona funeral home)

15:00 Arrival of the patient at Alcor

15:27 Start of patient cryogenic cooldown to LN₂ temperature

T+11 days 20:30 (est) New cooldown program malfunction

T+12 days 00:02 Older cooldown system initiated

T+19 days 22:10 End of cooldown at LN₂ temperature

T+46 days 12:30 CT scans made at LN₂ temperature

T+94 days Transfer of patient to long-term maintenance at LN₂ temperature

Time Summaries

Event Duration
hrs: mins

237:47 From the time of pronouncement to patient arrival at Alcor:
17:13 hrs on T-0 days to 15:00 hrs on T+10 days

00:20 From arrival at Alcor to the start of cephalic isolation: 15:00 hrs to 15:20 hrs

00:15 From the start to the end of the cephalic isolation: 15:05 hrs to 15:20 hrs

00:27 From arrival at Alcor to start of cooldown: 15:00 hrs to 15:27 hrs

238:14 From time of pronouncement to start of cryogenic cooldown:
17:37 hrs on T-0 days to 15:27 hrs on T+10 days

5. Discussion

The time of legal death shown on the death certificate was 17:37 hrs but it is assumed that that was a clerical error, as the death certificate clearly stated that the patient was found on T-0 days.

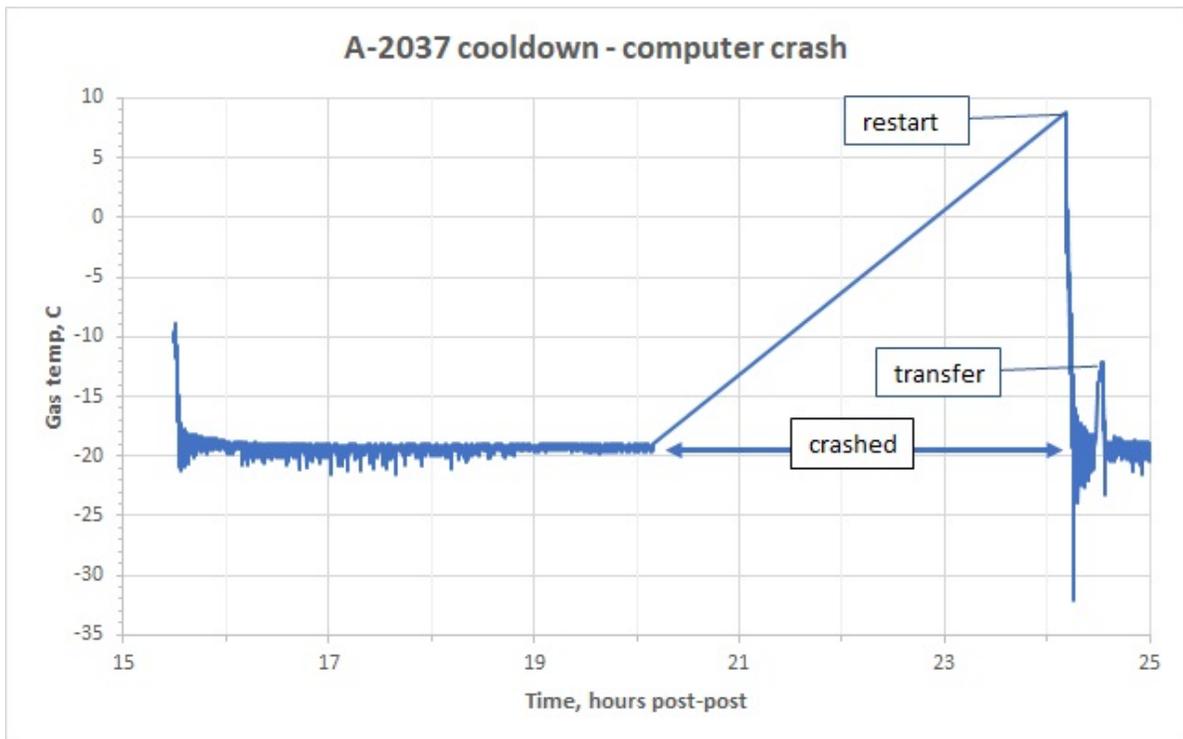
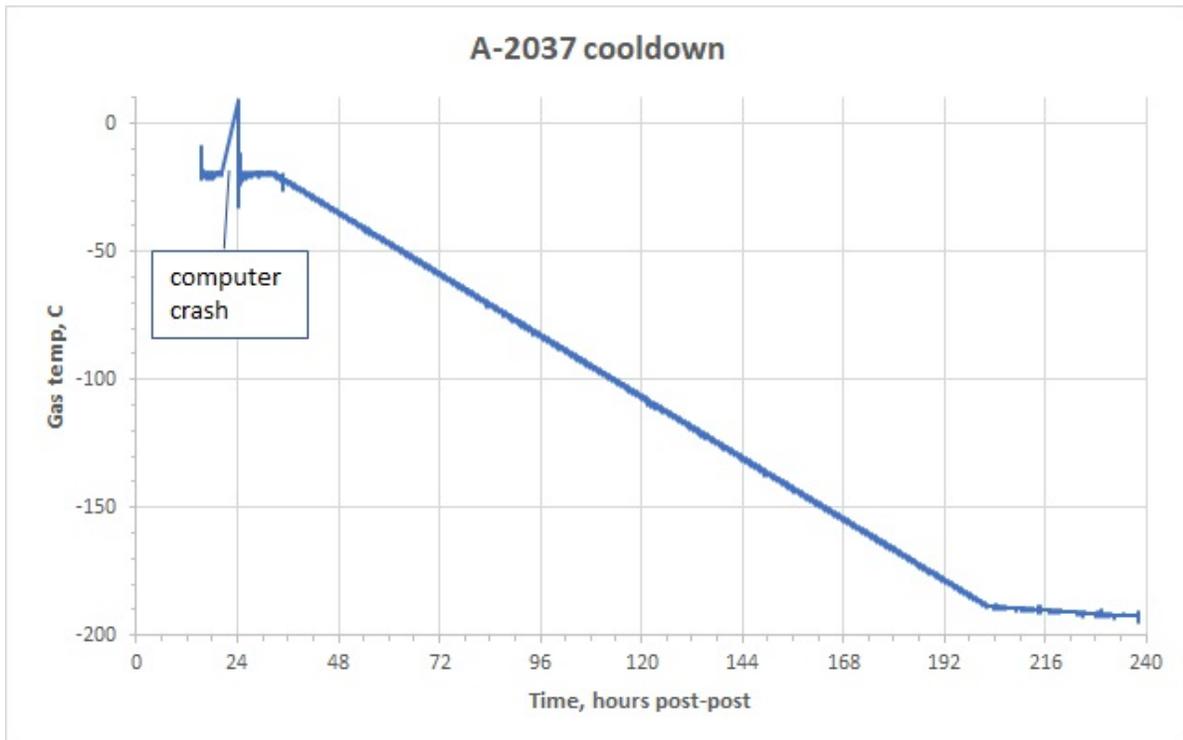
The member died an unattended death and suffered extreme delays since he was not found for an estimated 10 days or longer. To minimize this type of tragic situation for our members, Alcor has subscribed to a commercial opt-in service where members will be called daily by an emergency medical technician (EMT) to check on their medical situation and report to an emergency contact if deemed advisable. The member can also elect to check in daily, through a mobile app, instead of receiving a call. This program is still evolving as a means for minimizing the number of cases involving unattended deaths.

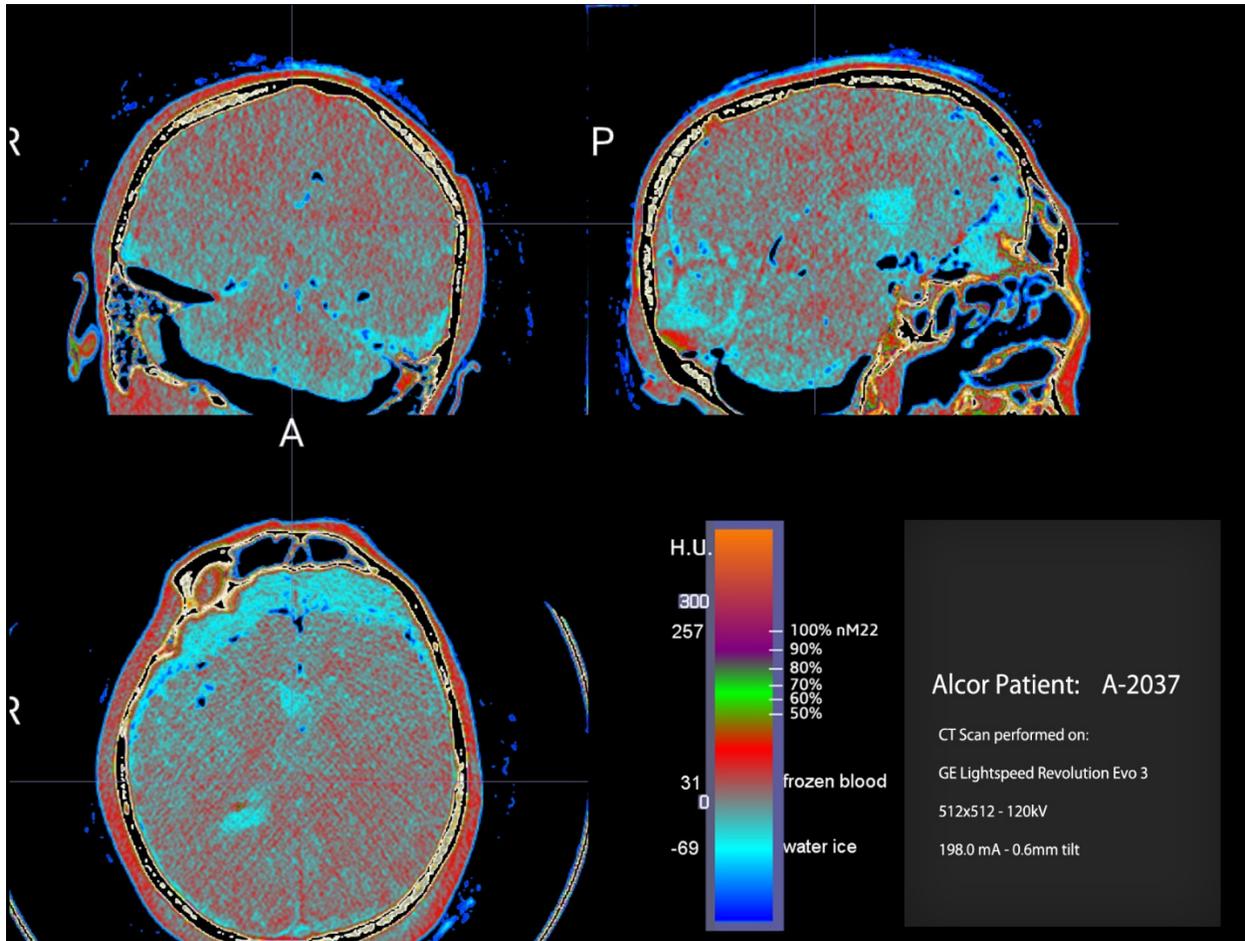
Temperature thermocouples were not placed in the patient upon arrival Alcor and prior to the start of cryogenic cooldown to minimize COVID-19 infection risks, therefore, there was no temperature recorded upon arrival and the cooldown temperatures do not reflect the temperature of the patient, but just the gas temperatures. In all future cases, maximum efforts will be made to place at least a nasopharyngeal temperature probe for temperature acquisition upon arrival and during cryogenic cooling if reasonably possible.

The cooldown computer was found at 00:04 hrs on T+11 days to be not running. The cooldown system had been reconfigured to be used on a new cart. The computer's bus could not supply sufficient power, so a USB hub was used. Unfortunately, a ground isolation issue arose at the USB ports of the data acquisition device. The solution was to install an opto-isolator circuit between the USB hub and the data acquisition device. In several tests following that change, and in the cases which used the reconfigured equipment, that appeared to have solved the problem.

It is believed that due to static discharge the data acquisition system failed in a state which did not disturb the dead man's switch, which normally would immediately trip the alarm. Consequently, an electronic isolation device was used to isolate the data acquisition circuit from the common ground of the cooldown system. Additionally, a secondary monitoring and cooldown failure alarm system (CFAS) is being developed and is currently in the final stages of implementation.

6. Graphs and CT Scans



Cryoprotectant Distribution (Post-cryopreservation CT scan)

The post-cryogenic cooldown CT scans were made on T+46 days. The patient was at liquid nitrogen temperature (-196°C). The brain had retained its shape (i.e., no apparent autolysis).