

**Alcor A-1546**

**Case Report**



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## 1. Member's Background

Leandro Remeons (a pseudonym assigned to maintain confidentiality) was born on November 26<sup>th</sup>, 1938. He started his membership with Alcor in 1995 at the age of 56. His health declined in his early 70's from metastatic gastric cancer and his clinical death occurred at 5:20 PM on November 9<sup>th</sup> of 2011 at the age of 72. Leandro was assigned member number A-1546.

## 2. Personnel

Aaron Drake, Medical Response Director, performed the immediate stabilization and cool down of the patient and was logistically supported by Max More, Ph.D., Alcor's CEO; Catherine Baldwin, General Manager of Suspended Animation; and Steve Harris, M.D., Chief Medical Advisor.

Personnel at Alcor's surgery suite included José Kanshepolky, M.D., Surgeon; Aaron Drake, Surgical Assistant; Hugh Hixon, Cryoprotection Perfusionist; Steve Graber, Assistant Cryoprotection Perfusionist; Bonnie Magee, Scribe; and R. Michael Perry, Ph.D., Cooldown Coordinator. Additional support was provided by Bruce Cohen and Jerry Searcy.

## 3. Pre-Deployment

In March of 2010, Alcor received an emergency text that Leandro Remeons, a member residing in the state of Washington, was seriously ill in the hospital. Aaron Drake was in Colorado at the time dealing with another Alcor patient. Apparently, during recovery from ankle surgery, Leandro began to experience severe abdominal bleeding, probably resulting from the doctor-ordered doses of aspirin and heparin designed to prevent blood clots. An upper gastrointestinal endoscopy examination was performed and a previously undetected ulcer was identified. The results from a biopsy was positive and confirmed the ulcer was cancerous. Alcor maintained frequent communication over the next few weeks as Leandro stabilized and began his radiation and chemotherapy treatments. After five weeks of radiation and two doses of chemotherapy, a PET-CT scan was not able to detect any remaining cancer.

A few months later in July of 2010, Leandro experienced a sudden onset of difficulty breathing and tests revealed a pulmonary embolism. An ultrasound identified the source of the clot from a deep vein thrombosis behind his knee. Anticoagulants were again administered to treat both clots and Leandro responded well and returned home from the hospital quickly. Over the next year, Alcor would inquire about the results from occasional follow-up PET-CT scans and receive reports that Leandro had remained cancer free.

In November of 2011, news came that Leandro was once again going into the hospital with difficulty breathing. While determining he had a slight case of pneumonia, medical providers also discovered his lungs were now riddled with metastatic gastric cancer. When the oncologist approached Leandro about a treatment regimen, Leandro said that he did not want to pursue any further treatment and asked the physician to call Alcor – “they would know what to do” he said.

His doctor did call and provided a diagnosis of his current condition and a prognosis that given Leandro’s decision not to treat his cancer, he may only have two to three weeks remaining to live. Both the attending physician and the hospital’s administration appeared to be supportive of honoring Leandro’s cryopreservation directives; however, they were already directing their hospice administration to begin the process of discharging Leandro to be cared for in his own home. Alcor did discuss with Leandro the possibility of relocating to Scottsdale for hospice to increase the likelihood of receiving a higher quality cryopreservation, but he wanted to remain at home with family. Alcor faxed a copy of Leandro’s directives to the hospice administration and began to establish rapport with them and discuss a variety of scenarios. Leandro was transferred back home on Monday November 7<sup>th</sup>.

On Tuesday, the hospice provided the first report of their visit to Leandro’s home and it was far too generalized and did not include much in the way of evaluating his health. Aaron spoke to the hospice administration about needing more information and the head of the department said she would make a personal visit to the patient’s home the next day to provide us with her interpretation of his condition and help establish a baseline of medical indices.

That same evening, just before midnight, the family called Alcor’s emergency answering service to give details of Leandro experiencing extreme difficulty breathing again. Aaron returned the call and Leandro’s spouse described the situation and expressed her concern that he may not survive the night. They had already contacted the hospice nurse but they would not respond as they said this was part of the dying process, so the family wanted to know what to do in the event he was pronounced without an Alcor team in place. Aaron described some ways to cool the body if needed and tried to evaluate the seriousness of his condition over the phone.

Aaron next contacted the remainder of Alcor’s deployment committee, Dr. Steve Harris of Critical Care Research, Catherine Baldwin of Suspended Animation along with Max More, Alcor’s CEO. They discussed the sudden deterioration of Leandro’s health and attempted to determine if this warranted a full team deployment or if this was a transient medical problem and Leandro still had “weeks remaining” as his physician had speculated just a few days prior.

It was decided to send Aaron in the morning as he could respond more quickly than the Suspended Animation team due to geographical location. Aaron would take a single person standby kit that would allow him to initiate a stabilization, if needed, while the remainder of the

team was en route. They asked Aaron to report back to the Deployment Committee after a personal assessment of Leandro's health could be made.

#### **4. Deployment**

When Aaron arrived at the Seattle airport later that same day, Wednesday, November 9<sup>th</sup>, he contacted the family to let them know he had arrived and would be at their home shortly. The hospice administrator that he had spoken to the previous day was also at the home to assess Leandro's condition and said she would stay there to meet him and to further discuss the expectations of their involvement.

Aaron arrived at the home at 3:50 pm. Introductions were made and Aaron got a chance to meet Leandro who was sitting up in the medical bed that had been positioned in the living room of the house. As Leandro had spoken to Aaron a number of times on the phone, he seemed pleased that he had arrived. Leandro's spouse asked if he understood who Aaron was and Leandro smiled, nodded, gave a thumbs-up and said "yes". Also present were his daughter, the hospice administrator and a few other relatives who had come for a big family meal.

The hospice administrator took the opportunity to review her findings about Leandro's current state of health. She laid out a plan for the family to effectively manage Leandro's discomfort over the course of the next week depending on the symptoms he exhibited, and called a local pharmacy to deliver her prescription orders. As Leandro seemed fairly tired from all of the people and activity in the house, the hospice administrator gave him another dose of oral Roxanol so he could get some rest. Leandro fell asleep immediately as she and Aaron continued to talk about different scenarios that might play out.

Leandro's breathing became increasingly shallow over the next 20 minutes prompting the hospice nurse to stay for a while longer, rather than returning to her office, fearing his clinical death could occur if his breathing continued to decline. Aaron quickly called Catherine Baldwin with the pending news and she said offered to help coordinate the activities of a local mortuary, whom she had contacted earlier in the day. Aaron went to the rental vehicle to bring in the single person standby kit so he could be ready in the event Leandro stopped breathing. Aaron had not obtained ice or coolers prior to coming to the home as he did not want to keep the hospice representative waiting, and no one had expressed any grave concern in Leandro's condition.

When Aaron returned to the bedside, he could sense the change in the environment, as the relatives were now very somber. Gathered around the patient, everyone watched as his breathing became less frequent until he simply stopped altogether. Aaron quickly donned his scrubs and personal protective gear while the nurse placed her stethoscope on Leandro's chest to listen for lung sounds or a heartbeat. Hearing none, she pronounced his clinical death at 5:20 pm, November 9<sup>th</sup>, 2011.

## 5. Field Stabilization, Cooling & Transportation

Leandro's daughter, who worked in occupational therapy, and a cousin who serviced and certified medical equipment, said they both wanted to help in any way possible. Given the circumstances, Aaron would accept the assistance from anyone, especially someone loosely familiar with a medical environment. Aaron asked them to get any ice and frozen vegetable bags from the kitchen freezer and send another family member to the closest convenience store to buy as much ice as possible.

Aaron quickly established intra-osseous (IO) access with the bone injection gun and drew up and administered the five small volume medications that do not require mixing, followed by a bolus of normal saline to flush. As Aaron drew up the medications, he showed the daughter how to push the fluid through the IO port. This was so he could continually draw up medications and hand them to the daughter to administer. In the meantime, a few blue ice containers and frozen vegetable bags that had been found were placed around the patient's head and axilla. The two assistants helped Aaron roll the patient onto one side to place the rectal occlusion device. Aaron pulled out the Lucas 2 chest compression unit and placed it over the patient. However, when it was turned on, nothing happened. The battery light indicated a full charge but the unit would not function. The AC power cord was obtained from the carrying case, connected to the unit and then plugged into the wall, and still it would not function. Losing precious minutes, the top of the unit was removed; however, the back board was left in place for support and Aaron started manual chest compressions. The cousin, who said he was trained in CPR, took over performing compressions. Aaron then placed and secured a King airway to facilitate passive air exchange through the chest compressions; however, there were not enough hands to provide active ventilation. A second IO was established in the left leg to allow for an Epinephrine drip to be administered through a Baxa dual-rate infusion pump. Working together, Aaron continued to draw up the large volume medications as the daughter pushed the medications through the access port.

Within 15 minutes, other family members had returned with around 200 lbs. of ice. Aaron asked them to place a layer of ice on the bottom of the bathtub and to clear a path from the living room to the bathroom. Once everyone was ready, the patient was lifted using the bed sheets and moved to the bathroom and placed into the tub. Aaron directed the two assistants to continue administering medications while he took a phone call from Catherine. She told him the mortuary would have a vehicle at the house within 30 minutes and they were also bringing additional bags of ice for transport. The plan was for the mortuary to prepare the patient for airline shipment that evening and deliver the package to cargo before they closed for the night. This would enable the patient to be on the first flight out in the morning.

Aaron returned to the patient to continue administering medications. Around 10 minutes later, a mortuary representative showed up with a vehicle and additional bags of ice. Aaron told him to keep the ice for transportation as they currently had an adequate supply. The representative mentioned that a second vehicle was on its way as he already had another body in the back of his and was just bringing the ice.

The last of the medications had been administered about the time the second vehicle arrived. The two mortuary representatives prepared the cot and completed administrative paperwork. Shortly thereafter, the patient was removed from the bathtub and placed into a body bag on top of the cot. The body bag was filled with bags of ice and loaded into the back of the transport vehicle. The mortuary representatives provided Aaron with copies of the paperwork and all of the needed contact phone numbers and then departed for the mortuary.

After cleaning up the environment, Aaron sat down to discuss the events with the family to help diffuse the impact of what they witnessed in an informal incident stress debriefing format. This also allowed him to gather additional background information on Leandro's life to assist him when writing the case report.

Contact was made with the funeral director to determine their packaging progress and to determine the likelihood they would be able to deliver the shipment to airline cargo. Aaron didn't want to book a seat on the plane until he was certain that he would be on the same flight. The funeral director said he would meet the deadline and would call to confirm after cargo had accepted the shipment. That call came at 10:15 pm. Aaron then booked his flight and called Max More to provide an update on the recent activities and the expected arrival time the next day.

Aaron arrived at the airport at 3:30 am the next morning and was able to connect with the cargo office and they reconfirmed the shipment was still scheduled to be on the flight. The flight departed Seattle SeaTac airport at 5:15 am PST and arrived Phoenix Sky Harbor airport at 9:00 am MST. Steve Rude, the funeral director that Alcor contracts with to handle the administrative and physical pickup requirements, had his team at the airline cargo office to receive the shipment. They called when they were en route to Alcor with the shipment to give the surgical staff an opportunity to be prepared.

## **6. Surgery and Perfusion**

The mortuary's transport vehicle arrived at Alcor and was greeted by the surgical team at the rear of the facility. Aaron unbuckled the straps that secured the air tray's cardboard lid. He then took a power screwdriver and removed the screws holding the Ziegler case's lid in place. The lid was lifted off and the body bag holding the patient was revealed. As the Ziegler case was too heavy

to move, the bags of ice that were stored inside the case were removed and placed into empty coolers. The Ziegler was now transferred to a church truck and rolled into the operating theater. Fresh bags of ice had been prepared and were placed on the operating table to create a bed of ice to rest the patient on. The body bag was unzipped and the internal bags of ice were removed. A Mega Mover sling was placed underneath the patient and used to make the transfer to the operating table and additional bags of ice were packed around the patient (16:42 post-arrest).

Aaron then left to scrub for surgery while Bruce Cohen shaved and prepped the patient's head with alcohol. Dr. José Kanshepolsky, who was already scrubbed, made two vertical incisions with a scalpel to expose the skull. The scalp was parted with retractors and two burr holes were made using a Codman perforator. The time from incision to completing the burr holes took 6 minutes. Crackphone elements were then placed in each burr hole. Meanwhile, Aaron had returned and placed a nasal probe thermocouple into the patient's nasopharynx and secured it using a skin stapler.

The patient's face and chest was draped, leaving only the neck exposed. It took José six minutes to isolate the left carotid artery and another five minutes to isolate the right carotid artery. Both arteries were tied off by José and Aaron severed them with a #11 scalpel blade. Using scalpels, José and Aaron separated the tissue around the neck, leaving only the spinal column intact. The cephalon was isolated with an osteotome and mallet and then moved from the operating table to the neuro box and mounted in the head ring (17:39 post-arrest).

The pump had been running to prime the system and chill it to  $+3^{\circ}\text{C}$ , the flow was adjusted to run perfusate through the cannulas at a low rate, and the circuit was configured from recirculation mode to washout mode. Both arteries were cannulated with red robinson catheters and secured using basket stitches. The team observed good washout and vertebral artery reverse flow, and bypass circulation was clamped off. The vertebrals were clamped off when the reverse flow became clear. When washout was determined complete by observation of the blood coloring of the effluent from the neck vessels, the perfusion circuit was configured back from washout to closed circulation, and Steve Graber switched on the ramp and Hugh Hixon put the upper skirt and lid on the perfusion box and plugged in the thermistor controlling LN2 injection into the box to drop the exterior perfusion temperature to  $+3^{\circ}\text{C}$  (18:13 post-arrest)

The ramp pump speed was set to raise the cryoprotectant concentration to the halfway point in roughly two hours and the main pump speed was set for a perfusion pressure of about 100 mmHg. At this pressure, this resulted in a flow rate of about 500 ml/min; quite good. The cryoprotectant was M22.

Twenty-six minutes into the cryoprotectant ramp, the back pressure on the main pump had risen to 22 psi, near the limit for the silicone pump shoe, due to loading of the 0.2 micron filter by



residual blood cells, and the second 0.2 micron filter was switched into the circuit, the back pressure then dropping back to 6 psi (18:34 post-arrest).

Forty-eight minutes into the ramp, brain retraction of about 5 mm was observed in both burr holes, and the eyeballs were collapsing from dehydration by the cryoprotectant, a positive indication that at 19 hours post-arrest, the blood-brain barrier was still intact.

One hundred and thirty-four minutes into the cryoprotectant ramp, the halfway point in the cryoprotection was determined by the refractive index of the effluent cryoprotectant from the jugulars, and the ramp was paused to allow the brain to equilibrate with the circulating cryoprotectant (20:22 post-arrest). The perfusate and box temperatures were reduced to  $-3^{\circ}\text{C}$ . Brain retraction was 10 mm in the left burr hole and 8 mm in the right. Due to unusual filter loading, a third 0.2 micron filter was swapped into the circuit.

One hundred and fifty-five minutes into the cryoprotection, the ramp was restarted, at the maximum flow rate for the ramp pump.

Over the next 90 minutes, the second half of the cryoprotection was done, with the pump speed being reduced by a factor of four over that period to maintain a perfusion pressure near 100 mmHg as the viscosity of the cryoprotectant increased because of increasing concentration and lower temperature, and the vascular resistance of the brain also increased from volume shrinkage.

The cryoprotection was ended 243 minutes after its beginning (22:11 post-arrest), the desired cryoprotectant concentration having been over the desired terminal concentration in the effluent from both jugular veins for over 30 minutes. Brain retraction was; left, 15 mm, right 12 mm. Good. From a CAT scan done afterward, the reduction in brain volume was about 50%.

The cryoprotected head was disconnected from the perfusion circuit, the skin over the burr holes was stapled closed, and the head was removed from the perfusion box, carried into the patient care bay, and placed in a precooled LR40 dewar for cooldown. The cooldown lid was placed and taped to the dewar, electronic and LN2 connections made, and the cooldown program started at 22 hours, 35 minutes post-arrest. In this case, the cooldown protocol was: plunge to  $-100^{\circ}\text{C}$ , descend to  $-190^{\circ}\text{C}$  at  $1^{\circ}\text{C/hr}$ , and descend from  $-190^{\circ}\text{C}$  to LN2 temperature in thirty hours. Between  $0^{\circ}\text{C}$  and  $-117^{\circ}\text{C}$ , the brain is still plastic and strains from the different contraction rates of bone, cryoprotected brain, etc. are relieved by plastic flow. Colder than that, plastic flow no longer suffices and stresses are relieved by cracking, which this cooldown protocol attempts to minimize. Cooldown ended at 0009 hrs, 15 Dec, 2011, 5 days, 5 hours, and 49 minutes post-arrest.

## 7. Timelines:

### Stabilization

**09 November, 2011**

Pacific Standard Time

Time / Post arrest

- 1720 (0:00) Patient pronounced  
Permission to begin procedures given
- 1723 (0:03) IO established in right leg
- 1724 (0:04) Minimal ice placed around patient's head and axilla  
Rectal occlusion device inserted
- 1725 (0:05) 200 mg Propofol administered
- 1726 (0:06) 100,000 IU Heparin administered  
200 IU Vasopressin administered
- 1727 (0:07) 15mg Ketorolac administered
- 1728 (0:08) 60 mg Gentamicin administered  
60 cc saline bolus given to flush medications
- 1730 (0:10) Lucas 2 failed to operate
- 1732 (0:12) Manual chest compressions started
- 1733 (0:13) King airway (size 4) placed and secured  
355 cc Maalox administered through King airway
- 1736 (0:16) A second IO port was established  
Epinephrine drip initiated  
Ice layer placed in bathtub
- 1738 (0:18) 250,000 IU Streptokinase administered
- 1740 (0:20) Patient moved to bath tub and covered in ice.
- 1745 (0:25) 300 mg Aspirin in 10 cc THAM administered  
190 cc THAM administered
- 1748 (0:28) 250 ml Hetastarch administered
- 1751 (0:31) 400 mg SMT in 50 cc Citrate-Dextrose administered
- 1753 (0:33) 2.0 g Ni-Ky in 100 cc Citrate-Dextrose administered  
First transport vehicle shows up with additional ice
- 1755 (0:35) 500 ml Mannitol administered
- 1800 (0:40) 70 ml Vital-Oxy administered
- 1810 (0:50) Second transport vehicle shows up with additional personnel  
Patient is placed into body bag, loaded onto cot and filled with ice bags
- 1825 (1:05) Patient departs for mortuary  
Clean-up at patient's home begins

2215 (3:55) Confirmation from mortuary that shipment was accepted by airline cargo

### **10 November, 2011**

0515 (10:55) Airplane with Aaron and shipment depart Seattle airport for Phoenix

(Mountain Standard Time)

0900 (14:40) Airplane lands at Phoenix Sky Harbor airport

Shipment received from cargo by Rude Family Northwest Mortuary

1044 (16:24) Patient arrives Alcor facility

### **Surgical**

10 November, 2011

Time / Post arrest

1044 (16:24) Patient arrives Alcor facility

1102 (16:42) Patient on table

1110 (16:50) Burr holes completed

1124 (17:04) Crackphone elements placed in burr holes

1126 (17:06) Nasal temperature probe place

1128 (17:08) Burr hole temperature +5.9° C

1130 (17:10) Video Camera started

1136 (17:16) Left carotid artery isolated

1141 (17:21) Right carotid artery isolated

1143 (17:23) Both carotids cut

1154 (17:34) Cephalic isolation completed

1157 (17:37) Cephalon moved to neuro box

1159 (17:39) Cephalon secured in neuro box

1200 (17:40) Carotid cannulation started

1210 (17:50) Carotid cannulation completed

1212 (17:52) Observed good venous return and vertebral flow

1228 (18:08) Washed out, going on ramp

1230 (18:10) Dr. Kanshepolsky notes there was excessive pus associated with this patient and we should assume he had a significant infection. Extra precautions should be taken to prevent contamination.

1233 (18:13) Hugh plugs in LN2

1442 (20:22) Paused ramp at ~50% CNV

1448 (20:28) Brain retraction L = 10 mm, R = 8 mm

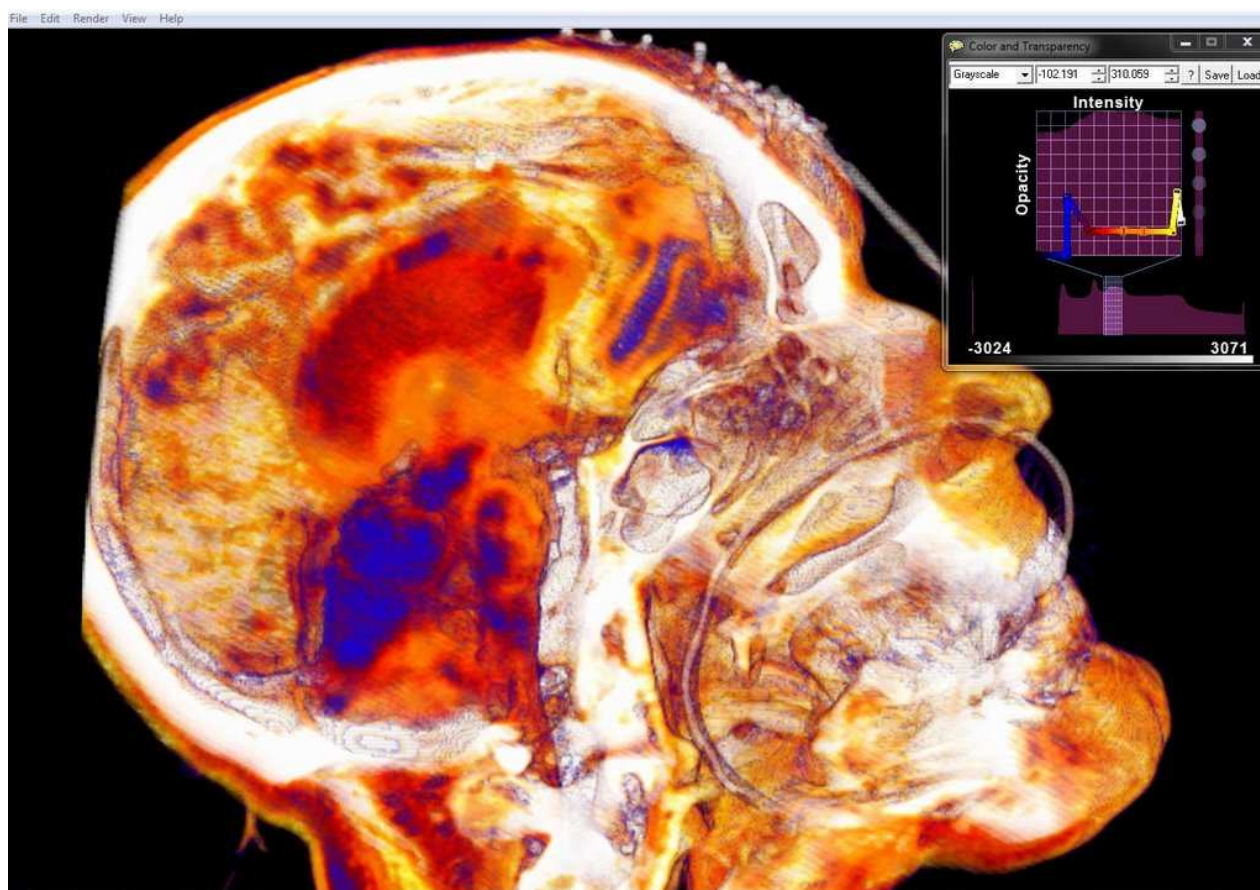
1455 (20:35) Swapped out loaded filter

1503 (20:43) Restart ramp at -3° C

- 1600 (21:40) Added 3 liters concentrate, effluent overflow problem  
1615 (19:55) Ramp off  
1631 (21:11) Pumps shut off, end of cryoprotection  
Over 50.35 Brix from both jugulars for over 45 minutes  
1634 (21:14) Brain retraction L = 1.5 cm, R = 1.2 cm  
1655 (22:35) Cool down initiated - plunge to -80° C  
1730 (23:10) Cleanup began

On 1 December, A-1546 was taken to a nearby medical facility for a CAT scan. The visualization developed by Steve Graber is shown below.

On 7 December, A-1546 was packed into to a neurocan and placed in permanent storage in LN2.



## 8. Discussions and Recommendations:

**Problem:** The Lucas 2 chest compression unit failed in the field.

**Solution:** The unit was sent back to the manufacture for repair and covered free of charge under the extended warranty plan Alcor purchased. Alcor's second Lucas 2 is also being sent back for evaluation to hopefully prevent future failure.

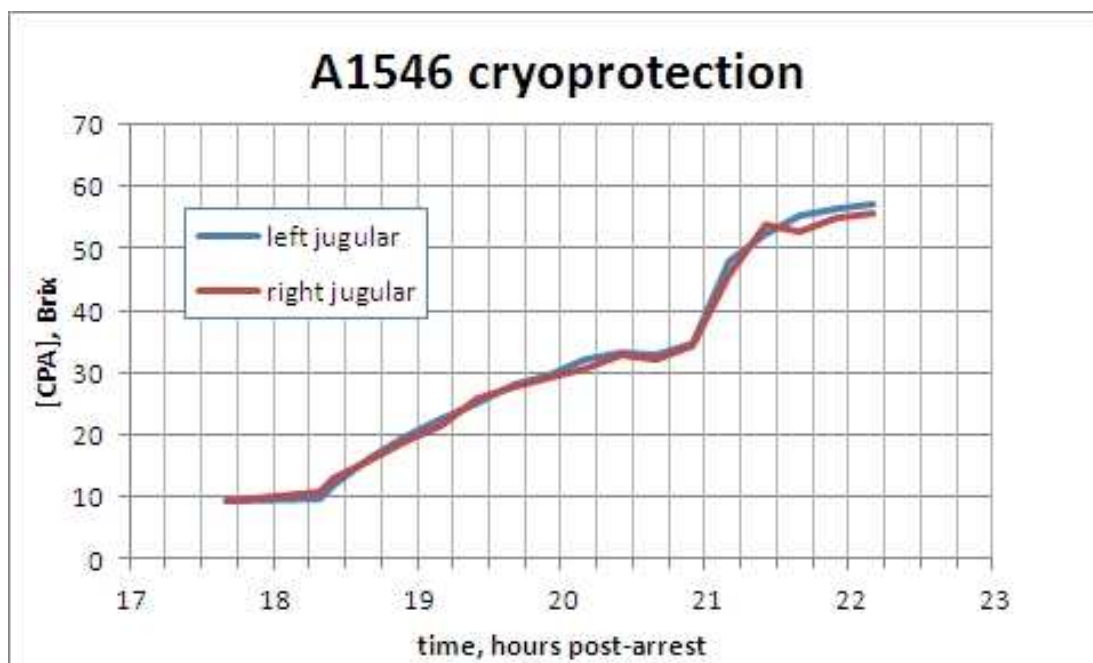
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**Problem:** The nasal probe for the DuaLogR was missing from the response kit.

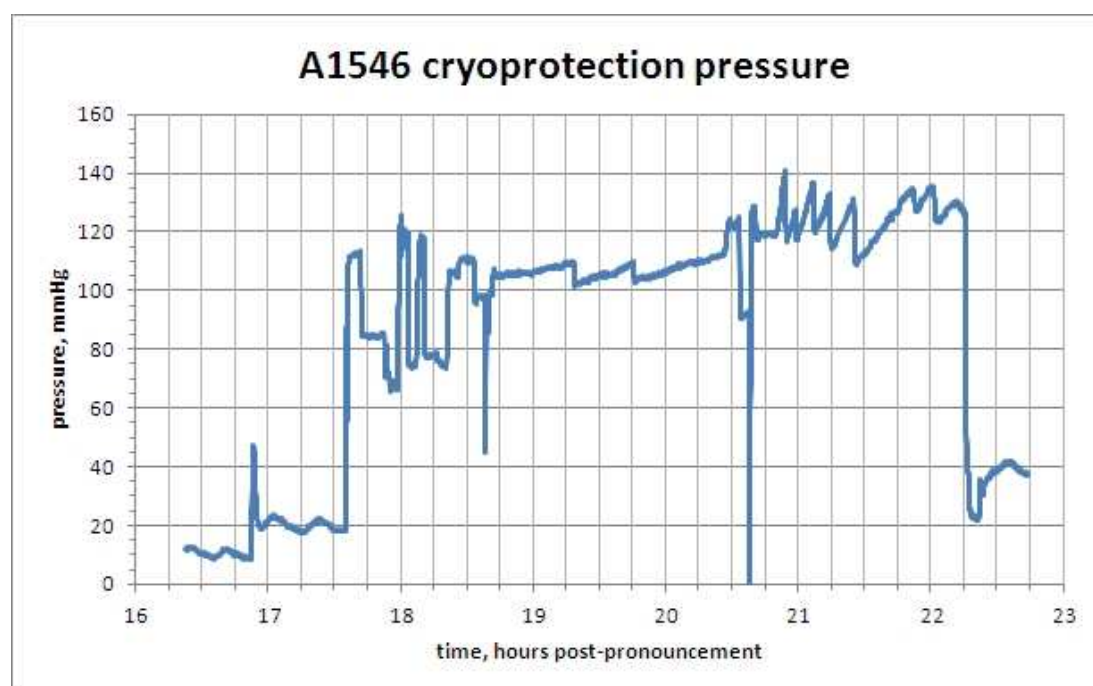
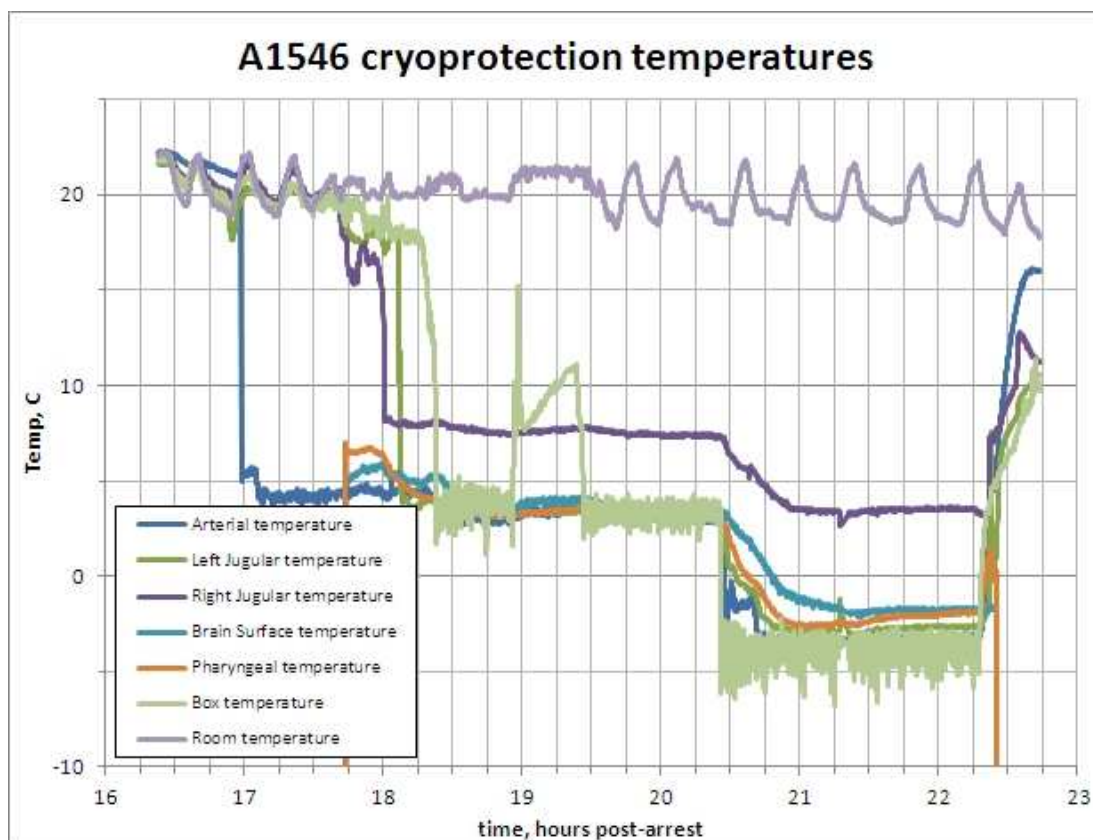
**Solution:** This single person standby kit was put together last minute before departure and this item was accidently omitted. A separate response kit will be created in the event of a similar scenario occurring.

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**Problem:** No cooler or ice was purchased upon arrival in Seattle.

**Solution:** This decision was based upon the desire to meet with the hospice administrator at the home and the lack of urgency expressed by her. We will try to make this activity an immediate priority on future deployments.

## 9. Graphs





- End of report -