

# **Alcor A-1845**

## **Case Report**



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**Alcor A-1845 Case Report Contents:**

1. Summary.....Page 3

2. Patient Assessment and Pre-Deployment.....Page 3

3. Preparation and Deployment.....Page 3

4. Stabilization.....Page 4

5. Field Surgery and Cryoprotection.....Page 4

6. Transport.....Page 7

7. Cooling to Liquid Nitrogen Temperature.....Page 7

8. Timeline and Time Summaries.....Page 8

9. Table of Medications Administered .....Page 10

10. Table of Concentrations (Brix) of nM22 Solution.....Page 12

11. Discussion.....Page 13

12. Graphs and CT Scans.....Page 14

## 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-1845 was an 83-year-old male with neuro cryopreservation arrangements. He suffered from dementia and stroke. He was pronounced legally deceased in Florida at 22:30 hrs on T-0 days in July of 2021. Per the death certificate, the cause of death was atrial fibrillation. A [Field Cryoprotection](#) (FCP) was performed.

After stabilization and field cryoprotection, the patient was air transported to Alcor for cryogenic cooldown. The patient arrived at Alcor on T+2 days at 17:05 hrs. The cooldown was initiated at 17:09 hrs and terminated at 16:30 hrs on T+6 days. CT scans were made of the patient's brain at 11:00 hrs on T+15 days. The patient was transferred to long-term maintenance at liquid nitrogen temperature at 12:43 hrs on T+17 days.

## 2. Patient Assessment and Pre-Deployment

### T-78 days

Alcor was notified at 12:12 hrs by the member's daughter that the member had advanced dementia and had been enrolled in in-home hospice care to receive assistance in daily living activities. He received a visit that day from an RN, an MD, and an aide. He was roughly 5'7" and weighed 54 kg. The member's eating and drinking had decreased about 50%.

### T-46 days

The member had been on the Watch List and Alcor's MRD had stayed in close contact with the family and the hospice organization to receive updates on the member's condition. Hospice personnel informed Alcor at 09:13 hrs that when legal death is predicted to be imminent, they would have an RN in the home 24/7 until cardiac arrest. They reported no significant changes in the member's condition.

## 3. Preparation and Deployment

### T-0 days

The member's daughter sent a text message to Alcor at 11:50 hrs explaining that the member's eating and drinking had slowed over the last few days. Hospice personnel were present and advised that legal death appeared to be imminent.

Alcor's Deployment Committee officially deployed International Cryomedicine Experts (ICE) to perform standby, stabilization and transport (SST) and the field cryopreservation procedure, based on earlier discussions with Alcor's scientific advisors.

The member stopped breathing at 21:38 hrs. ICE had arranged for a subcontractor to be at the member's bedside to wait for the hospice personnel to arrive to declare legal death. (Hospice personnel were not on site in advance as they had previously promised.) ICE personnel were still enroute to Florida after their flight was cancelled and had to be rescheduled.

A funeral director was enroute to the patient's location with 100 pounds of water ice. The member's family placed the ice bags around the member at 21:40 hrs, prior to pronouncement of legal death. Hospice personnel arrived and officially declared the member to be legally deceased at 22:30 hrs.

#### **4. Stabilization**

An intraosseous line was started in the right tibia fossa at 23:24 hrs and the first stabilization medication was administered (See the below Table of Medications Administered for the names of the medications, doses, and times of administration). Chest compressions were also initiated at 23:24 hrs and delivered continuously during the administration of the medications as assistance was enlisted from the funeral home.

#### T+1 days

After the stabilization procedure was complete, the patient was turned over to the funeral director at 00:44 hrs and transported to the funeral home for the field cryopreservation procedure. The official ICE team landed in Florida at 07:44 hrs and they arrived at the funeral home at 09:02 hrs.

#### **5. Field Surgery and Cryoprotection**

A nasopharynx thermocouple was placed at 09:40 hrs and the patient's scalp was prepped at 09:42 hrs to establish the burr holes. At 09:43 hrs the temperature datalogger would not turn on. The batteries were replaced but the unit still did not function. It was not possible to obtain temperature data (see the Discussion section).

Using a Codman perforator, the right burr hole was established at 09:45 hrs. The left burr hole was established at 09:47 hrs and then the burr holes were cleaned. At 09:51 hrs thermocouple

probes were placed (one in each burr hole) and secured with a surgical stapler. The right carotid artery was raised at 09:55 hrs. The left carotid artery was raised, secured, and tied at 10:03 hrs. The right carotid artery was secured and tied at 10:07 hrs.

Fluid was flowing out of the vertebral arteries before cannulation. There was minor leaking around the vertebral arteries and cannulae due to there being no way to secure the cannula without pinching it off.

The cephalic isolation was initiated at 10:18 hrs and completed at 10:20 hrs. At 10:24 hrs the cephalon weighed 4.40 kg. An eyebolt was placed in the vertebra at 10:26 hrs for ease of handling during cryogenic cooldown. The left carotid artery was cannulated with a red Robinson catheter at 10:35 hrs and the right carotid artery was cannulated with a red Robinson catheter at 10:47 hrs. The perfusion tubing was primed with bladder #1 at 10:48 hrs.

[Field Cryoprotection](#) (FCP) was initiated at 10:54 hrs by hanging cryoprotectant bladder #2 (bladder concentration 0.05 concentration needed to vitrify (CNV) on the elevated tripod (see the below Table of Concentrations (Brix) of nM22 Solution). In spite of the absence of temperature measurements due to the data logger not functioning, the arterial temperature was expected to be several degrees above 0°C, and several degrees below zero after addition of the ethylene glycol to the heat exchanger ice bath.

By hanging two bladders with different cryoprotectant concentrations on a teeter-totter atop an elevated tripod, a smoother transition of increasing concentrations of cryoprotectant can be achieved (see the Discussion section for a more detailed explanation of the field equipment). The pressure gauge was not functioning so the perfusion pressure was estimated. The perfusate bladders were hung an estimated 36-38" above the infusion site. The arterial pressure induced by this elevation was estimated to be 74-78 mmHg at the cannula.

The left vertebral artery was cannulated at 11:00 hrs with a 12 French (Fr) catheter. The right vertebral artery was cannulated at 11:07 hrs, also with a 12 Fr catheter.

Bladder #/3 (bladder concentration 0.08 CNV) was hung at 11:08 hrs.

Bladder #/4 (bladder concentration 0.14 CNV) was hung at 11:20 hrs. A sample taken from the jugular effluent at 11:24 hrs showed a cryoprotectant concentration of 12.0 Brix.

Bladder #5 (bladder concentration 0.23 CNV) was hung at 11:46 hrs. A sample taken from the jugular effluent showed a cryoprotectant concentration of 14.3 Brix.

At 11:50 hrs it was noted that bladders #6, #9, #12, #16 and #18 were leaking in the Pelican case.

Bladder #7 (bladder concentration 0.64 CNV) was hung at 11:54 hrs. A sample taken from the jugular effluent showed a cryoprotectant concentration of 20.1 Brix.

Bladder #8 (bladder concentration 1.06 CNV Brix, all subsequent bladders had the same CNV) was hung at 12:28 hrs. A sample taken from the jugular effluent at 12:30 showed a cryoprotectant concentration of 30.6 Brix.

There was no bladder #9 (due to leaking). Bladder #10 was hung at 12:53 hrs. A sample taken from the jugular effluent at 13:01 hrs showed a cryoprotectant concentration of 43.9 Brix. Ethylene glycol antifreeze was added to the ice in the heat exchanger at 12:55 hrs to lower the temperature of the perfusate below 0°C.

Bladder #11 was hung at 13:04 hrs. No sample was taken from the jugular effluent.

Bladder #12 was missing. Bladder #13 was hung at 13:29 hrs but had a leak so the bladder was not used. A sample taken from the jugular effluent at 13:41 hrs showed a cryoprotectant concentration of 49.4 Brix.

Bladder #14 was hung at 13:38 hrs. No sample was taken from the jugular effluent.

Bladder #15 was hung at 13:50 hrs. A sample taken from the jugular effluent at 14:01 hrs showed a cryoprotectant concentration of 51.2 Brix. The one-hour countdown to the termination of perfusion was initiated.

A sample taken from the jugular effluent line at 14:03 hrs showed a cryoprotectant concentration of 51.6 Brix.

Bladder #17 was hung at 14:24 hrs. A sample taken from the jugular effluent showed a cryoprotectant concentration of 51.6 Brix.

A sample taken from the jugular effluent line at 14.51 hrs showed a cryoprotectant concentration of 51.7 Brix.

Perfusion was discontinued at 14:55 hrs. At 14:59 hrs the cephalon weighed 4.97 kg which represented a 0.57 kg weight gain or 13%. The cephalon was moved into the neuro shipping container at 15:03 hrs and dry ice was added to the container at 15:06 hrs. The shipping container was closed at 15:10 hrs. As the temperature datalogger was not functional, it is assumed that dry ice temperature of the cephalon was attained 24 hours later.

## 6. Transport

### T+2 days

Dry ice was added to the neuro shipping container at 09:25 hrs. The patient departed local airport at 11:35 hrs and landed at the Scottsdale, Arizona airport at 16:42 hrs. The patient arrived at Alcor at 17:05 hrs. It wasn't possible to directly measure the patient's temperature upon arrival because field personnel removed temperature sensors after the field temperature datalogger didn't function. However, the patient was observed to still be covered by dry ice.

## 7. Cooling to Liquid Nitrogen Temperature

There was no burr hole or nasopharyngeal temperature data prior to cryogenic cooldown as the temperature datalogger did not function. The thermocouples had been cut and could not be replaced since the patient was at dry ice temperature.

The appropriate computer program was used to initiate cryogenic cooldown at 17:09 hrs on T+2 days, plunging to  $-110^{\circ}\text{C}$  and descending thereafter at  $-1^{\circ}\text{C}/\text{hour}$  to liquid nitrogen temperature. On T+6 days at 16:30 hrs, an uneventful cooldown was terminated. On T+15 days at 11:00 hrs, CT scans were made of the patient's brain at liquid nitrogen temperature. On T+17, the patient was transferred to long-term maintenance at liquid nitrogen temperature.

## 8. Timeline and Time Summaries

### Timeline

#### T-0 days

21:38 Estimated time of cardiac arrest  
21:40 Patient packed with ice bags (by family, prior to pronouncement)  
22:30 Pronouncement of legal death  
23:05 Placement of intraosseous device  
23:24 Start of mechanical chest compressions  
23:24 Administration of first medication (200 mg propofol)  
N/A No airway was placed

#### T+1 days

00:38 Administration of final medication (700 mL Vital-Oxy)  
00:38 Termination of cardiopulmonary support (no temperature available)  
00:40 Transport patient to mortuary (for surgery and cryoprotection)  
09:52 Start of field surgery  
10:18 Start of cephalic isolation  
10:24 Weight of patient cephalon (4.40 kg)  
10:54 Start of open circuit cryoprotection  
14:55 End of open circuit cryoprotection (final BRIX readings = 51.7)  
14:59 Weight of patient cephalon after perfusion (4.97 kg)  
15:06 Start of dry ice cooling

#### T+2 days

15:06 Dry ice temperature achieved (24-hour rule, no data logger)  
16:42 Departure of the patient from the remote airport  
17:05 Arrival of patient at Alcor (dry ice temperature)  
17:09 Start of patient cryogenic cooldown to LN<sub>2</sub> temperature

T+6 days 16:30 End of cooldown at LN<sub>2</sub> temperature

T+15 days CT scan at LN<sub>2</sub> temperature

T+17 days Transfer of patient to long-term maintenance at LN<sub>2</sub> temperature



## Time Summaries

### Stabilization

#### Event Duration

hrs: mins

- 00:52** From the estimated time of cardiac arrest (ETCA) to pronouncement of legal death:  
21:38 hrs to 22:30 hrs
- 43:27** From ETCA to the patient's arrival at Alcor: 21:38 hrs on T-0 to 17:05 hrs on T+2
- 01:46** From ETCA to start of cardiopulmonary support: 21:38 hrs to 23:24 hrs
- 01:46** From ETCA to start of medication administration: 21:38 hrs to 23:24 hrs
- 01:14** From start to the end of medication administration: 23:24 hrs on T-0 to 00:38 hrs on T+1

### Field Surgery and Cryoprotection

#### Event Duration

hrs: mins

- 12:14** From ETCA to start of surgery: 21:38 hrs on T-0 to 09:52 hrs on T+1
- 00:32** From the start of surgery to end of surgery: 09:52 hrs to 10:24 hrs
- 13:16** From ETCA to start of cryoprotection: 21:38 hrs on T-0 to 10:54 hrs on T+1
- 17:17** From ETCA to end of cryoprotection: 21:38 hrs on T-0 to 14:55 hrs on T+1
- 04:01** From the start of cryoprotection to end of cryoprotection: 10:54 hrs to 14:55 hrs
- 00:32** From the start of surgery to end of the cephalic isolation: 09:52 hrs to 10:24 hrs
- 01:02** From the start of surgery to the start of the cryoprotection: 09:52 hrs to 10:54 hrs
- 05:03** From the start of surgery to the end of the cryoprotection: 09:52 hrs to 14:55 hrs

### Cryogenic Cooldown

#### Event Duration

hrs: mins

- 02:14** From the end of cryoprotection to the start of cooldown: 14:55 hrs to 17:09 hrs
- 43:31** From ETCA to start of cooldown: 21:38 hrs on T-0 to 17:09 hrs on T+2
- 00:04** From arrival at Alcor to the start of cooldown: 17:05 hrs to 17:09 hrs

## 9. Table of Medications Administered

TIME	MEDICATION	DOSE	PURPOSE
T-0 23:24 hrs	Propofol	200 mg	Anesthetic; reduces cerebral metabolic demand; reduces the theoretic possibility of increased awareness during aggressive CPS.
23:28 hrs	Sodium citrate	20 g total Note 2	Anticoagulant; prevents blood clot formation.
23:30 hrs	Heparin	50,000 IU	Anticoagulant; prevents blood clot formation.
23:30 hrs	Vasopressin	20 IU total Note 3	Vasopressor; increases blood pressure during CPS.
23:31 hrs	Minocycline	200 mg	Antibiotic and neuroprotectant
23:31 hrs	SMT (S-methyl-isothiourrea)	400 mg Note 4	Neuroprotectant (iNOS inhibitor); protects the brain from ischemic injury; raises blood pressure.
T+1 00:20 hrs	Decaglycerol/THAM [tris(hydroxymethyl)aminomethane]	60 cc total (first dose) Note 5	Decaglycerol inhibits cerebral edema. THAM is a buffer to mitigate acidosis.
00:20 hrs	Streptokinase	250,000 IU Note 6	A thrombolytic used to break up existing blood clots.
00:34 hrs	Decaglycerol/THAM [tris(hydroxymethyl)aminomethane]	140 cc (second dose)	Decaglycerol inhibits cerebral edema. THAM is a buffer to mitigate acidosis.
00:36 hrs	Vital Oxy	324 cc total Note 7	Antioxidants: melatonin, vitamin E (D-alpha tocopherol), PBN (alpha Phenyl t-Butyl Nitron) and anti-inflammatory carprofen.

### Notes:

1. Except for the decaglycerol/THAM, the field notes did not show the exact amounts administered. The amounts shown in the above Table are based on the Medications Protocol.
2. The standard formulation for sodium citrate is 20% w/v. 10 grams of sodium citrate are given to patients who weigh less than 40 kg, and 20 grams are given to patients who weigh over 40 kg. This patient received 20 grams of sodium citrate because his weight was over 40 kg.
3. Vasopressin is a fixed dosage of 40 IU, per dose for two doses. The second 40 IU dose to be administered concurrently with Vital-Oxy, I.V. The field notes do not state that the second dose

was administered. Vasopressin is to be administered only if the patient's temperature is above 20°C as it is ineffective at cold temperatures.

4. SMT (S-methyl isothiourea) is a fixed-dose and is a powder, (1 vial = 400 mg) dissolved in 10 mL of saline and injected through a 0.2  $\mu$  filter. SMT is unstable in solution with a useful life of approximately six hours.
5. Decaglycerol/THAM is administered as a custom formulation of 20% w/v decaglycerol and 4.5% w/v THAM (tromethamine) in water (pH = 10.4 and pKa = 8.3).
6. The standard administration of streptokinase is 250,000 IU dissolved in 5 mL of 9% sodium chloride and infused through a 0.2  $\mu$  filter. Per the Medications Protocol, streptokinase is to be added to the washout solution, but since this was a field cryopreservation it was administered directly to the patient.
7. The medications protocol dilutes 70 mL or less, based on body weight, of Vital-Oxy into 150 mL of saline for a total of 220 cc of diluted Vital-Oxy saline. It appears that Christine diluted the 70ml of Vital Oxy into a 250cc bag of saline for a total of 320cc. The full amount of Vital Oxy was administered, however, the patient would have received an additional 100cc of saline. Each mL of Vital-Oxy contains 194 mg Sigma Cremophor EL (or Sigma Kolliphor EL), 155 mg ethanol, 19.4 mg PBN, 3.24 mg carprofen, 1.55 mg melatonin, and 198 IU vitamin E.
8. Maalox was not administered as no airway was used.

## 10. Table of Concentrations (Brix) of nM22 Solution

A-1845 step-ramp, nM22						
Endpoint is 49.9 Brix from both jugulars for 1/2 hr						
2-liter bag labeled	[nM22], CNV	Brix (calc)	bag started, hr:min post-arrest	bag flow rate, ml/min	Brix, effluent	Comments
2	0.05	11.81	13:16	143		
3	0.08	13.14	13:30	167		
4	0.14	15.35	13:42	77	12.0	
5	0.23	19.03	14:08	250	14.3	
7	0.50	29.85	14:16	59	20.1	bag 6 missing
8	1.06	52.306	14:50	80	30.6	
10	1.06	52.306	15:15	182	43.9	bag 9 missing
11	1.06	52.306	15:26	80	49.4	bag 12 missing
13	1.06	52.306	15:51	222		
14	1.06	52.306	16:00	167		
15	1.06	52.306	16:12	154	51.2	
16	1.06	52.306	16:25	95		
17	1.06	52.306	16:46	100	51.6	
18	1.06	52.306	17:06	182		
			17:17		51.7	END

Note: The Endpoint of 49.9 Brix was the suggested point for termination of perfusion, but the standard one-hour countdown to the termination of perfusion resulted in the final refractive index reading being 51.7 Brix (see the Discussion section for more details).

## 11. Discussion

At the beginning of the field cryoprotection procedure the temperature datalogger would not turn on. The batteries were replaced but the unit still did not function. It was not possible to obtain temperature data. The commercially available data loggers too often do not function when needed. This has resulted in the Alcor technical staff developing their own data logger (called a universal data logger or UDL) which will be more reliable and will be available for use soon. Until the UDL is available for use in the field, Alcor will also make sure that two data loggers are in each kit. Field personnel have since been informed that temperature probes should remain installed for later use at Alcor.

Perfusate bags were found to have been damaged when the kit was opened at the funeral home. A vacuum sealer has been purchased to help prevent this and a meeting will be held to discuss updating the shipping containers.

The end point was nM22x1.06 (106%) which has been determined by field experience to obtain a refractive index for over 100% from both jugulars for ½ hour in reasonable time. To reduce the perfusion time, concentrations of up to nM22x1.08 (108%) would be acceptable but the higher viscosity could slow the perfusion.

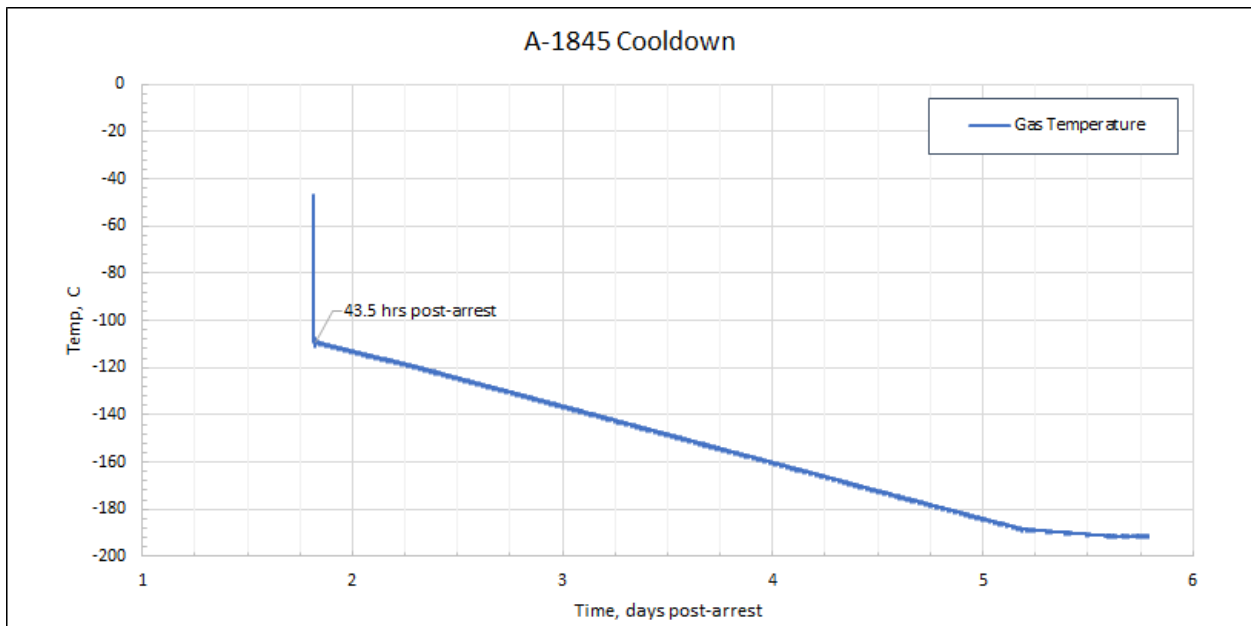
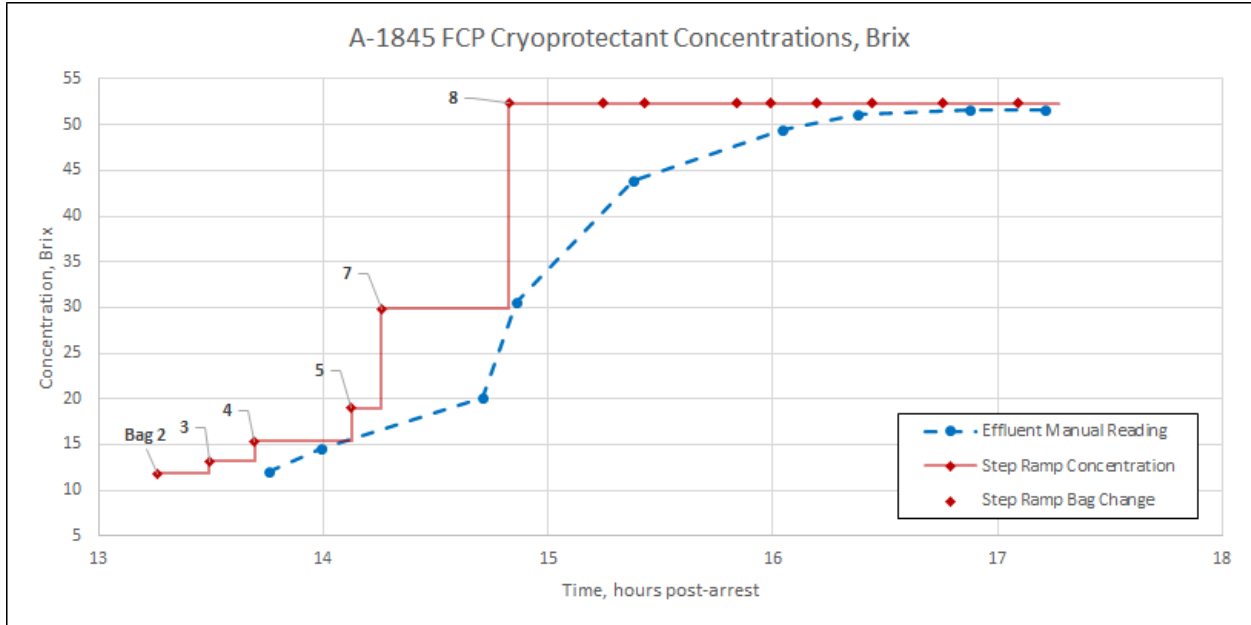
For this case, the endpoint was probably reached at the end of bladder 15, but perfusion continued for another 52 minutes, probably because they had more bags than they needed. If the refractometer had been used more often in this case, it would have helped guide the decision about when to terminate perfusion.

Alcor's strategic partner, International Cryomedicine Experts (ICE) discussed with Alcor staff that the shape, size and weight of the current Pelican neuro shipper make it difficult to transport (lifting, rolling, etc). Additionally, the unusual shape causes it to be singled out during TSA inspections to be opened. The proposed solution was to do what all other organ donation groups apparently do and that's to use standard off-the-shelf coolers which are commonly available everywhere. There should be no issues with using this method on short-haul continental flights. Reduced insulation efficiency of said coolers could be a problem for longer flights.

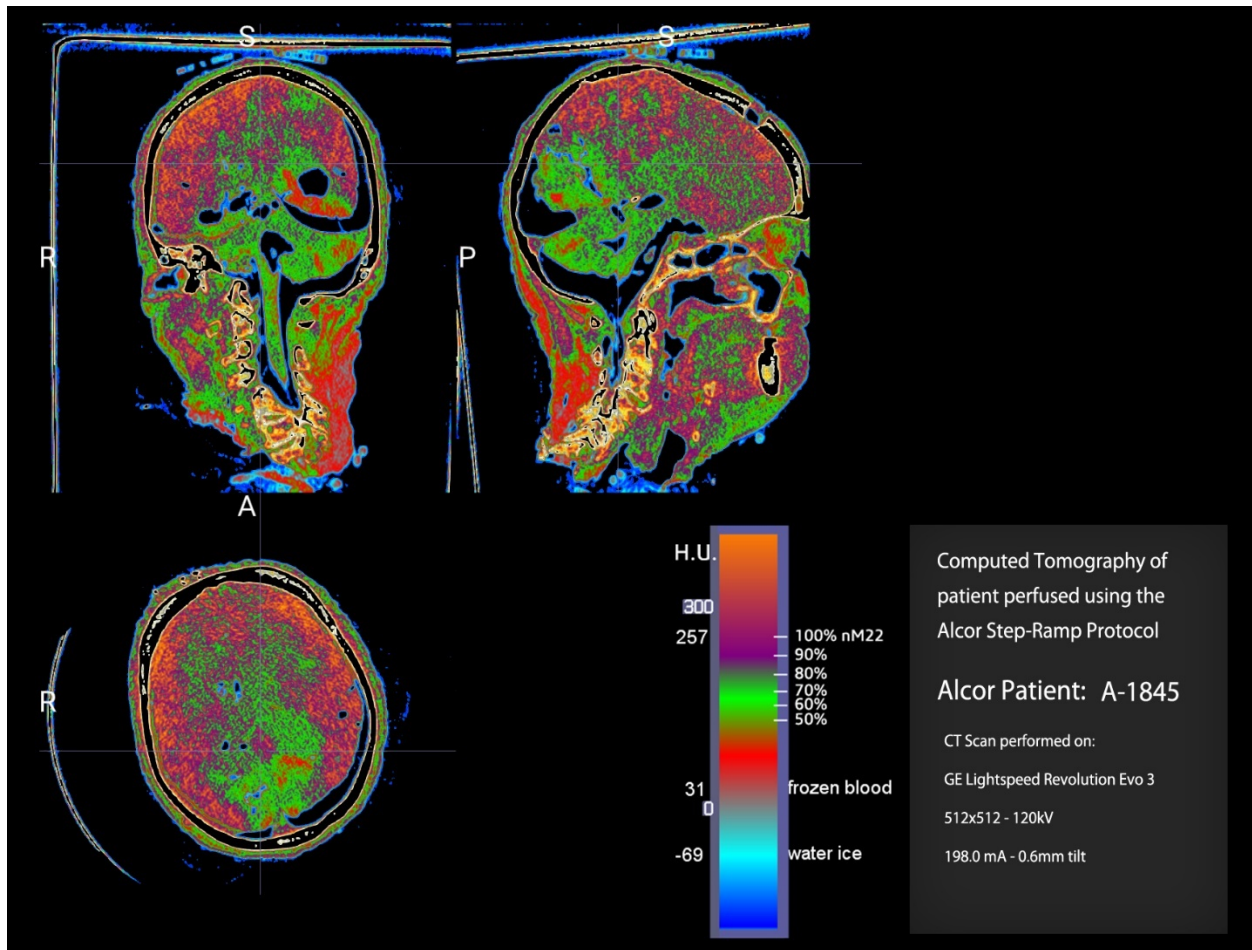
The CT scan shows about 50% of the brain having cryoprotectant concentration levels below that are deemed necessary for vitrification, presumably due to ischemic delays, suboptimal cooling, and delayed anti-coagulant administration.

After the kit was returned to Alcor, it was found that three bags of perfusate had been left in the cases without being placed into appropriate refrigeration or informing Alcor staff. All team members have received additional education on the importance of placing leftover bags into appropriate cooler upon return to Alcor.

## 12. Graphs and CT Scans



**Cryoprotectant Distribution (Post-cryopreservation CT scan)**



The post-cryogenic cooldown CT scan was obtained on August 7, 2021; the patient was at liquid nitrogen temperature (-196°C).