Alcor A-3648

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, T-X represents occurrences before T-0, and T+X represents occurrences following T-0.

A-3648 was a 66-year-old member with neuro cryopreservation arrangements who suffered from brain cancer (meningioma) that originated in the spine and metastasized to the skin and brain. Cardiac arrest took place at 03:15 hrs on T-0 days and the member was pronounced legally deceased in California at 03:16 hrs on T-0 days in October of 2023.

After stabilization and field cryoprotection (FCP), the patient was packed in dry ice and driven to Alcor for cryogenic cooldown. The patient arrived at Alcor on T-0 days at 20:29 hrs. The cryogenic cooldown was initiated on T-0 days at 20:45 hrs and terminated on T+4 days at 18:04 hrs. The patient was transferred to long-term care at liquid nitrogen temperature on T+16 days at 14:30 hrs.

2. Patient Assessment

T-25 days

The member's family contacted Alcor's MRD and reported that the member had been referred to home hospice care on T-20 days by an oncologist after a shave biopsy report on T-35 days, showing metastasis of brain meningioma to the skin. The family did not know more, and the patient had memory deficits that made it difficult to find out the original date of diagnosis.

T-24 days

It was learned that the cancer had originated in the spine and had metastasized to the brain as well as the skin. The member was on service with in-home hospice care. One of the member's family was a hospice nurse who stated the member had weeks rather than months to live, because the member was malnourished with "little reserve." Two months prior, the member had zero lesions on the brain but was now showing multiple lesions, an indication that the lesions were rapidly growing.

The member's vital signs were blood pressure (BP) 166/95, heart rate (HR) 85, capillary oxygen saturation (SPO2) 97% on room air, temperature 37°C. The MRD had planned once a week calls but changed to 2x/week following this update.

T-15 days

The member was on a slow decline, was still walking and talking, but with decreased gait and strength. No solid nutrition was being taken, only fluids. The member was experiencing frequent nausea. Two new cancer lesions were noted on the forehead. A hospital bed had been ordered for the home in preparation for a continued decline in mobility.

The member was experiencing increasing pain. The pain medication regimen was changed from Vicodin to liquid morphine. The hospice nurse visits were changed to twice weekly and respite care was added at three times a week. The member's vital signs were: Active BP (after getting

up from a chair) 144/86, HR 87, T 36°C, SPO2 98%. The member's current weight was 131.4 lbs. (having recently lost 5 lbs.).

The family was now well informed and agreed to notify the MRD if the member became immobile, had changes to the fluid intake, or to report any changes in the vital signs. The MRD planned to call the hospice staff to go over Alcor's policies and procedures and ensure they were on board.

T-13 days

The MRD spoke with hospice nurse regarding the importance of prompt pronouncement and the concern that the member's house was 45 minutes away from the main hospice facility. The nurse was cooperative and agreed to expedite pronouncement. Since the member was full code (to be resuscitated after cardiac arrest), they would have to call 911, which could respond more quickly. The member was to sign a DNR/DNI (do not resuscitate or intubate) upon the arrival of the Alcor team. The MRD planned to contact a local, frequently used funeral home to confirm their services, which was successful.

The family reported that the member was drinking water, but had taken no food for six days. The member was not tolerating any liquid nutrition as it still resulted in nausea. The member's skin turgor, or elasticity, was still fair, indicating no dehydration. The member's weight was now down to 126 lbs., which was a total loss of 10 lbs. The vital signs were: BP 165/96, HR 91, SPO2 99%, non-labored RR of 16, T 37°C, clear light-yellow urine output of 200-500 mL per day.

T-12 days

The member's vitals that morning were: 146/89 (a 20-point drop with no pain medication being given), HR 89 and bounding visible in neck, SPO2 96%. No edema was noted. Slight rales/crackles could be heard in the dependent right lower lobe of the lungs. Bowel sounds were hypo-active but present in all four quarters. The member was no longer able to tolerate water without severe nausea and declined all fluids. The member was no longer experiencing pain. The Vicodin and morphine were no longer being administered. The urine output appeared to have decreased, and was no longer clear light yellow, but amber.

3. Deployment

The Alcor Deployment Committee called a Level-1 deployment at 13:05 hrs, in preparation for a Field Cryoprotectant Perfusion (FCP.)

Sidebar:
The medical personnel on the Alcor Deployment Committee have established a list of medical indicators to assist in determining whether to call either a Level-1 standby, a high probability of death within seven days, or a Level-2 standby, a medium probability of death within seven days. The Deployment Committee voting members use these criteria when considering if a deployment is necessary.

The funeral home confirmed that they would transport the patient following the cephalic isolation and provide the death certificates. The Alcor Deployment and Recovery Team (DART)

arrived at the home of the member at 17:09 hrs. The member's vitals were: BP 152/91, HR 80, SPO2 96%, T 37°C, RR 14. The member was responsive.

4. Standby

T-11 days

The member's family requested that the DART team members not be at the house until after the member went into cardiac arrest. The MRD explained to them that it was important that the DART team be there before cardiac arrest to start procedures immediately upon pronouncement

The family replied that the member had since the previous afternoon not taken any liquids. The member still recognized family members but only gave short replies to any questions. The member had requested to be left alone in the bedroom with the door closed, and the family complied. The family felt that when the member no longer responded to a close family member, and was no longer bothered by noise, they would open the bedroom door and report that decline to the MRD and the team members. The family had baby monitors in place to listen to any calls from the member, and the bedroom was only 3 to 5 feet away from the family members.

No vital signs had been taken by the family that morning. The vital signs taken by the hospice nurse that afternoon were: BP 127/75, HR 93 and bounding, irregular but with no discernable pattern, T 37°C, SPO2 98%. At 13:45 hrs, the member was given Zofran to control nausea, morphine for pain control, and haloperidol for agitation. The medications gave good results.

T-10 days

The member's vital signs were: BP 101/67, HR 88, T 36°C, RR 10, SPO2 Sat 96%. The member responded to verbal requests to open mouth for medications, but was not talking to the family. The member shifted position from right side to back, three times that afternoon. The member was resting quietly after vitals were taken and medications given. The member did not close the mouth after medications were given. There was no choking, but the member was watched closely to make sure the medications did not drip from the mouth. The member appeared to be dehydrated, based on the dry mouth and skin.

T-9 days

The member's vital signs were: BP 124/79, HR 113 with some missed beats, T 37°C, SPO2 93%. The member woke up at 07:00 hrs and tried to stand up, required the use of a walker and maximal assistance from family. When up and standing, the bladder released an unmeasured amount of urine onto the floor. It was not possible to assess the color of the urine. It took two family members to stabilize the member while the bladder drained. The member was unable to sit back onto the bed without assistance. Two family members were required to get the member back into bed and positioned.

The member's respiration rate was 10 and shallow, with intermittent short apnea of 3 to 5 seconds that caused the heart rate to increase when the SPO2 dropped below 93%. The member did open the mouth for a thermometer and take the medications when requested, but there were no verbalizations on that day. The hospice nurse took vitals: BP 118/79, HR 104, Resp 14. The on-call hospice nurse is about 45 minutes away from the member's home.

T-8 days

The member's vital signs were: BP 121/79, HR 108, and irregular, speeding up and slowing down, T 37°C, SPO2 94%. The member was resting quietly in bed. Per the family, the member appeared to be "sundowning" for the last 3 days, or going into a state of confusion occurring in the late afternoon and lasting into the night.

T-7 days

The member's vital signs were: BP 114/84, HR 106 to 110, SPO2 92-96%, RR 12 and not labored. The member had some unmeasured urine output overnight into a diaper. The color was dark yellow. The family felt that any urine output was from edema rather than hydration since the member had not taken any liquids. The facial lesions were not as "puffy" as earlier, and the large front bump had started to bleed when touched. The member did not speak that day, was confused, and wanted to stand up, but was too weak even with a walker and 2 persons assisting. The member sat on the edge of the bed for about 5 minutes, but had to be supported continuously to prevent falling/tipping.

The DART team spoke to Alcor staff about the potential for the member's dehydration being a possible hinderance to successful perfusion. It appeared that urine output at that time was only due to the internal draining of the member's edema, and not due to hydration. This was confirmed by the dark color of the urine. It was decided that the volume expander Hetastarch would be used during medications administration to mitigate the prolonged dehydration and increase cerebral perfusion during cardiopulmonary support (CPS).

T-5/6 days

There were no significant changes on these two days.

T-4 days

The member's vital signs were: BP 115/92, HR 109, T 38°C, SPO2 95%, RR 9. The member was still open mouth breathing with periods of apnea lasting 2-5 seconds. Some belly breathing was noted. The member was not speaking at all, and was moving arms and legs with difficulty when trying to reposition. There was an unmeasured amount of very dark urine in the diaper this day. The member tried to sit up by dropping one leg over the edge of the bed, but required maximal assistance to get the other leg over the edge, maximal assistance to get upright in bed, and maximal assistance to prevent falling back into the supine position. The member was resting comfortably.

T-3 days

The member's vital signs were: BP 121/83, HR 115, T 37°C, SPO2 95%, but would drop down to 91-90% with periods of apnea lasting 10 seconds 3 times per minute.

T-2 days

The member's vital signs were: BP 95/80, HR 118, T 37°C, SPO2 94%, RR 7 with up to 30 secs of apnea. The member was still able to shift position in bed. No signs of distress were noted. The member had now been 14 days without fluid intake.

T-1 days

The member's vital signs were: BP 83/57, HR 135, T 39°C, SPO2 89-83%, RR 26 and labored with no apnea present. Because the BP could not be read on the wrist as per usual, the nurse had to use the blood pressure cuff on the upper arm. The member still flinched to movement of the legs but no longer with movement of the arms.

T-0 days

At 02:49 hrs the member's family reported to the DART team that they were not able to obtain an SPO2 reading. They had called the hospice nurse to come check on the member and pronounce cardiac arrest and legal death, if needed.

The hospice nurse arrived at 03:15 hrs. The member went into cardiac arrest within a minute of the nurse's arrival. The member was pronounced legally deceased at 03:16 hrs.

5. Patient Recovery and Stabilization

The patient was placed into the portable ice bath (PIB) at 03:22 hrs to start external cooling. The last recorded patient temperature had been the previous day and was 39°C. An intraosseous device was placed in the right tibial plateau at 03:25 hrs to access the patient's vasculature for the administration of stabilization medications. Mechanical chest compressions using the ROS-Q device were initiated at 03:33 hrs to improve external cooling. A King airway was placed at 03:34 hrs to initiate ventilation.

The first stabilization medication was administered at 03:28 hrs (see the below Table of Medications Administered for the names of the medications, the dosages, and the times of administration).

6. Field Surgery

At 03:24 hrs the patient was transported in Alcor's mobile surgical vehicle (MSV) to a private location where surgery and cryoprotectant perfusion would be performed in the MSV. The patient arrived at the private location at 03:50 hrs. After preparation of the surgical area, cardiopulmonary support was terminated at 04:36 hrs in order to start surgery, which commenced at 04:39 hrs.

The right carotid artery was cannulated at 04:53 hrs with an 18 French (Fr), right-angle cannula. The left carotid artery was cannulated at 05:02 hrs with an 18 Fr, right angle cannula. The vertebral arteries could not be located and were not cannulated (see the Discussion section). Using scalpels, the tissues of the neck were cleared away in preparation for the cephalic isolation at 05:25 hrs. Using an osteotome and mallet, the spinal cord was severed, and the

cephalic isolation was completed at 05:32 hrs. Using a Codman perforator, the burr hole was started at 05:05 hrs and completed at 05:09 hrs. A thermocouple was placed into the burr hole.

The MSV power supply was not working properly (see Discussion section), meaning there was no power to the heat exchange pump. The vehicle had to be moved to a location with an outside power outlet. This slowed initiation of the field cryoprotection for about 1.5 hours.

7. Field Cryoprotectant Perfusion

The open circuit, gravity-induced cryoprotectant perfusion was initiated at 07:00 hrs using Bladder #1, which contained the calculated concentration of nM22 needed to vitrify (CNV) of 11.81 Brix, and a molarity of 0.47. See the below Table of Concentrations (Brix) of nM22 Solution, for the times the bladders were started, the precalculated concentrations of each bladder, and the refractive index of effluent samples taken.

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 first bladder was hung and opened to flow, and the second bladder was opened when the first bladder was about half empty. The third bladder was hung when the first bladder was empty and opened when the second was about half empty, and so on.

The height of the bladders on the teeter totter was 39 inches which is (39 x 2.054 mmHg per inch of height =) 80 mmHg, the maximum arterial pressure at the infusion site. The goal is to have the pressure between 70 and 80 mmHg and the bladders can be raised or lowered as needed to optimize flow and protect the vasculature. Ethylene glycol antifreeze at 50/50 concentration was added to the water in the heat exchanger at 08:24 hrs to produce temperatures below 0°C, and the 30-minute pause for equilibration was initiated.

Sidebar:
Per the cryoprotection protocol, the ramp is to be paused at 30 Brix (50% of the desired terminal concentration) to allow the patient to come to osmotic equilibrium. When the bladder system is used, bladders 5 & 6 represent the pause. At the end of the 30-minute pause, the ramp is resumed at the maximum addition rate (maximum without losing total volume in the circuit) to go to 105% of the desired end concentration (52.5 Brix) and held between 102% and 105% concentration until the terminal concentration is obtained.

The bladder system cryoprotectant perfusion was terminated at 09:45 hrs. The terminal refractive index reading was only 41.1 Brix, and a molarity of 9.91, but the flow rate was extremely slow and the 3-hour limit for perfusion (to prevent toxicity) had been reached (see Discussion section).

The cephalon was moved into the dry ice shipper at 10:06 hrs, and covered with approximately 30 lbs. of dry ice.

8. Patient Transport to Alcor

The funeral director used for this case was some distance from the member's home. The DART team met the funeral director halfway to their home location to deliver to them the remains for cremation at 16:28 hrs. The DART team departed from that location at 16:30 hrs with the cephalon stored on approximately 30 lbs. of dry ice in the neuro shipper container. The Hobo data logger was not functioning at all during this case, resulting in a loss of temperature data (see the Discussion section).

9. Cooling to Liquid Nitrogen Temperature

The patient arrived at Alcor at 20:29 hrs. Arrival temperatures were: LNPT -41.3°C, RNPT -38.7°C, with a safe amount of dry ice left in the shipper. The burr hole thermistor had been dislodged during transfer.

Computer-controlled cryogenic cooldown was initiated at 20:45 hrs on T-0 days, plunging to -80°C and descending thereafter at -1°C/hour to liquid nitrogen temperature. On T+4 day at 18:04 hrs, an uneventful cooldown was terminated. On T+16 days at 14:30 hrs, the patient was transferred to long-term care at liquid nitrogen temperature.

10. Timeline and Time Summaries

Timeline

T-0	03:15	Time of cardiac arrest
T-0	03:16	Time of pronouncement of legal death
T-0	03:22	Start of ice bath cooling
T-0	03:24	Start transport of patient to funeral home
T-0	03:25	Placement of IO device
T-0	03:28	Administration of first medication (propofol)
T-0	03:29	Administration of sodium citrate
T-0	03:33	Start of mechanical chest compressions /ventilation
T-0	03:34	Placement of King Airway
T-0	03:50	Arrive at funeral home
T-0	03:54	Administration of final medication (decaglycerol/THAM)
T-0	04:36	Stopped of cardiopulmonary support
T-0	04:39	Start field surgery
T-0	04:53	Start cannulation
T-0	05:09	Place burr hole and insert thermocouple
T-0	05:10	Completed cannulation
T-0	05:25	Start cephalic isolation
T-0	05:32	Completed cephalic isolation
T-0	07:00	Start of bladder perfusion (FCP)
T-0	09:45	Termination of FCP
T-0	10:06	Start dry ice cooling
T-0	16:28	Start transport of patient to Alcor
T-0	20:29	Arrival of patient at Alcor operating room
T-0	20:45	Start of cryogenic cooldown
T+4	18:04	Terminate cryogenic cooldown
T+16	14:30	Transfer patient to long term care at LN2

Time Summaries

Event Duration hr:min		days	time	
Stabilization				
00:01	From:	T-0	03:15	Time of cardiac arrest
	Till:	T-0	03:16	Time of pronouncement of legal death
00:07	From:	T-0	03:15	Time of cardiac arrest
	Till:	T-0	03:22	Start of ice bath cooling
00:18	From:	T-0	03:15	Time of cardiac arrest
	Till:	T-0	03:33	Start of mechanical chest compressions /ventilation
00:13	From:	T-0	03:15	Time of cardiac arrest
	Till:	T-0	03:28	Administration of first medication (propofol)
00:26	From:	T-0	03:28	Administration of first medication (propofol)
	Till:	T-0	03:54	Administration of final medication (decaglycerol/THAM)
01:24	From:	T-0	03:15	Time of cardiac arrest
	Till:	T-0	04:39	Start field surgery
00:53	From:	T-0	04:39	Start field surgery
	Till:	T-0	05:32	Completed cephalic isolation
03:45	From:	T-0	03:15	Time of cardiac arrest
	Till:	T-0	07:00	Start of bladder perfusion (FCP)
02:45	From:	T-0	07:00	Start of bladder perfusion (FCP)
	Till:	T-0	09:45	Termination of FCP
06:30	From:	T-0	03:15	Time of cardiac arrest
	Till:	T-0	09:45	Termination of FCP
00:53	From:	T-0	04:39	Start field surgery
	Till:	T-0	05:32	Completed cephalic isolation
02:21	From:	T-0	04:39	Start field surgery
	Till:	T-0	07:00	Start of bladder perfusion (FCP)
05:06	From:	T-0	04:39	Start field surgery
	Till:	T-0	09:45	Termination of FCP
00:21	From:	T-0	09:45	Termination of FCP
	Till:	T-0	10:06	Start dry ice cooling
06:51	From:	T-0	03:15	Time of cardiac arrest
	Till:	T-0	10:06	Start dry ice cooling
17:14	From:	T-0	03:15	Time of cardiac arrest
	Till:	T-0	20:29	Arrival of patient at Alcor operating room
00:16	From:	T-0	20:29	Arrival of patient at Alcor operating room
	Till:	T-0	20:45	Start of cryogenic cooldown

11. Table of Medications Administered

T-0 days

TIME	MEDICATION	DOSE	PURPOSE
03:28 hrs	Propofol	200 mg	Anesthetic; reduces cerebral metabolic demand; reduces the theoretic possibility of increased awareness during aggressive CPS.
03:29 hrs	Sodium citrate	20 g Note 1	Anticoagulant; prevents blood clot formation.
03:35 hrs	Heparin	50,000 IU	Anticoagulant; prevents blood clot formation.
03:36 hrs	Vasopressin (1st dose)	40 IU Note 2	Vasopressor; increases blood pressure during CPS.
03:37 hrs	Minocycline	200 mg Note 3	Antibiotic and neuroprotectant
03:39 hrs	SMT (S-methyl-isothiourea)	400 mg Note 4	Neuroprotectant (iNOS inhibitor); protects the brain from ischemic injury; raises blood pressure.
03:40 hrs	Decaglycerol/THAM	200 ml Note 5	Decaglycerol inhibits cerebral edema.
03:42 hrs	Antacid	60 cc Note 6	A buffer used to neutralize stomach acid.
03:47 hrs	Vasopressin (2nd dose)	40 IU Note 7	Vasopressor; increases blood pressure during CPS.
03:47 hrs	Vital Oxy (w/ saline)	40 ml Note 8	Antioxidants: melatonin, vitamin E (D-alpha tocopherol), PBN (alpha Phenyl t-Butyl Nitrone) and anti-inflammatory carprofen.
03:54 hrs	Decaglycerol/THAM	200 ml Note 5	Decaglycerol inhibits cerebral edema.
07:00 hrs	Streptokinase	25,000 IU Note 9	A thrombolytic used to break up existing blood clots.

Notes:

1. The standard formulation for sodium citrate is 20% w/v, in sterile packaging provided by the manufacturer. 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 weighed 57 kg and therefore received 20 grams of sodium citrate.

2. Vasopressin is a fixed dosage of 40 IU, per dose for two doses. The second 40 IU dose is to be administered concurrently with Vital-Oxy, I.V. Vasopressin is to be administered only if the patient's temperature is above 20°C as it is ineffective at cold temperatures.

3. SMT (S-methyl isothiourea) is a powder, (1 vial = 400 mg) dissolved in 10 mL of saline and injected through a 0.2 µ filter. SMT is unstable in solution with a use life of approximately six hours.

4. 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). It is a fixed dose of 200 ml.

5. An antacid can be given in several doses, totaling 250 mL, and inserted through the nasogastric tube in an airway.

6. 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. 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.

7. The standard administration of streptokinase is 250,000 IU fixed dose, dissolved in 5 mL of 9% sodium chloride, to be added to the blood washout solution prior to remote blood washout, or to the first cryoprotection flush in the OR. The dosage is reduced to 25,000 IU in field neuro (FCP) cases and added to the first bladder). This medication previously needed to be infused through a 0.2 µ filter. The medication now in use is already sterile-filtered and can be reconstituted in the vial.

12. Table of Concentrations (Brix) of nM22 Solution

A-3648 step-ramp, nM22

Preferred endpoint is over 49.9 Brix from both jugulars for 1/2hr

2L Bag label number	[nM22], CNV	Molarity of penetrating CPAs*	Brix (calc)	Bag start hh:mm, MST	hrs post pronounc-ement	Bag avg. flow rate, mL/min		Sample time hh:mm, MST	Effluent Conc., Brix
1	0.05	0.47	11.81	7:00	4.00	90.9		8:15	15.9
2	0.08	0.78	13.14	7:22	4.37	111.1		8:26	20.9
3	0.14	1.29	15.35	7:40	4.67	100.0		8:50	24
4	0.23	2.15	19.03	8:00	5.00	83.3		8:58	32.8
5	0.50	4.67	29.85	8:24	5.40	500.0		9:05	35.3
6	0.50	4.67	29.85	8:28	5.47	500.0		9:22	38.2
7	1.06	9.91	52.306	8:32	5.53	111.1		9:45	41.1
8	1.06	9.91	52.306	8:50	5.83	36.4			
END				9:45	6.75				

* does not account for concentration of non-penetrating CPAs

13. Discussion

Standby and Stabilization

The Hobo data logger was not working properly, causing delays to troubleshoot during stabilization. New data loggers that are more resilient, more user friendly, and better suited for the subzero temperatures of our procedures, have been purchased and they are now in all the kits.

Only two DART members were on this case, so some tasks were not able to be completed as quickly as they could have, had there been a full team. In the future there will be a minimum of 4 personnel in all cases.

Field Surgery and Washout

The power outlet box is only good for a couple of hours of use. Utilizing electronic coolers is extremely limited and powering the perfusion system for 3 hours is nearly impossible. Having another method of plugging standard index electrical cords is required. Alcor has purchased a cigarette lighter port to duplex receptacle outlet converters. However, installing a solar charging device for the power box would be helpful. This has been brought to the attention of Alcor engineers who have suggested several options to resolve this and will meet with DART after each case to discuss improvements to the mobile recovery vehicle (MRV).

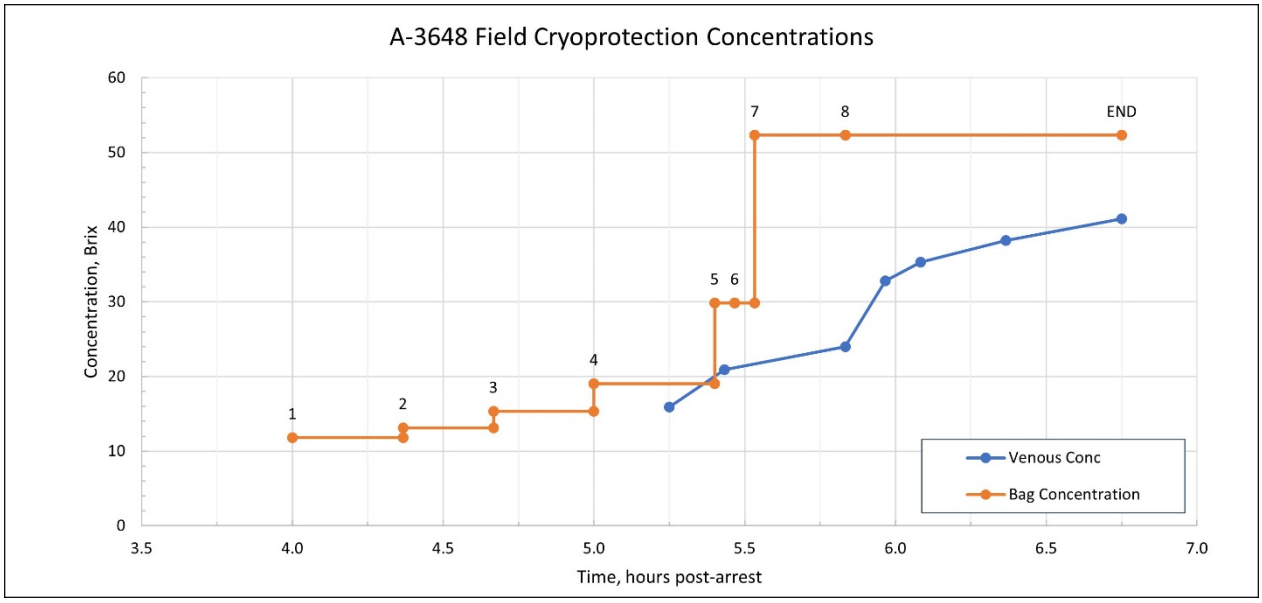
Perfusion in the MRV is limited due to height limitations, therefore, a Brix consistency of 49.9% is difficult to obtain within the 3-hour perfusion window (limit due to perfusion toxicity). The proper height of the tripod should be about 39 inches above the cephalon to produce a pressure of 80 mmHg. With limited height in the MSV, it is necessary to find ways to adapt. On this case, the cephalon was positioned forward in the surgical area and the perfusion system was stretched to the back hooks along the roof meant for the netting shelf.

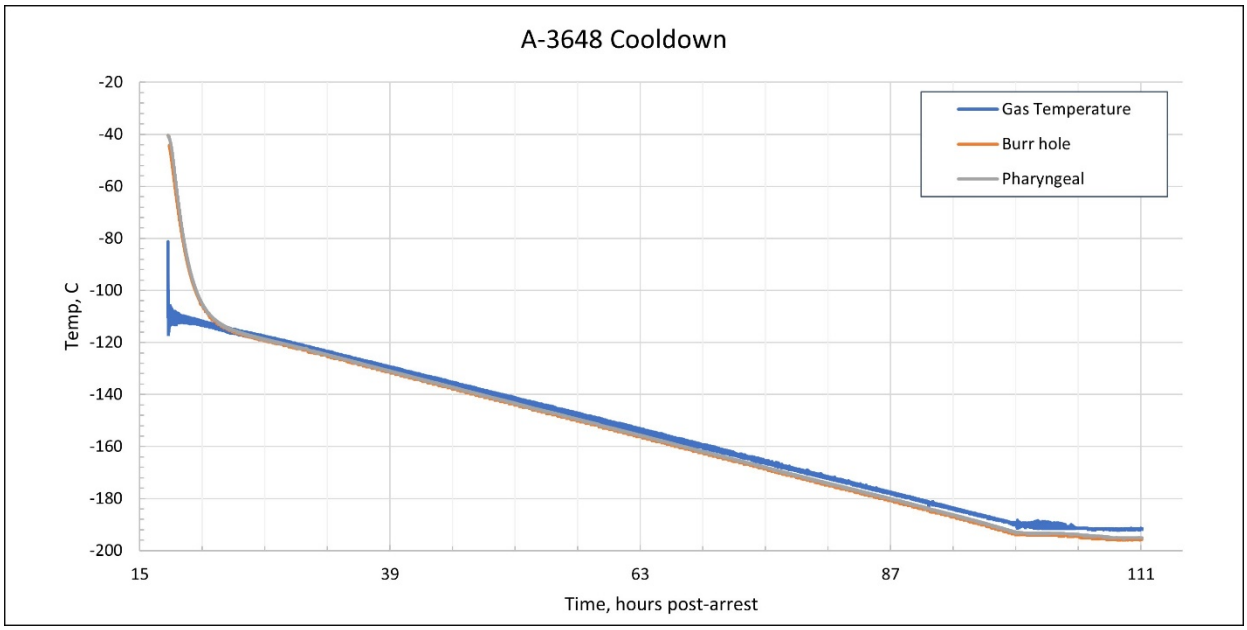
A collapsible cephalic perfusion cooler fills quickly during perfusion. Safe handling of biohazardous waste (bodily fluids) is difficult when doing a procedure in the MSV. This has been discussed with Alcor engineers. A bilge pump system will be built with a long hose to improve this process and to create a more sanitary SOP for all team members. The high case load has slowed progress on this, but this project will be completed as soon as possible. Materials have been purchased.

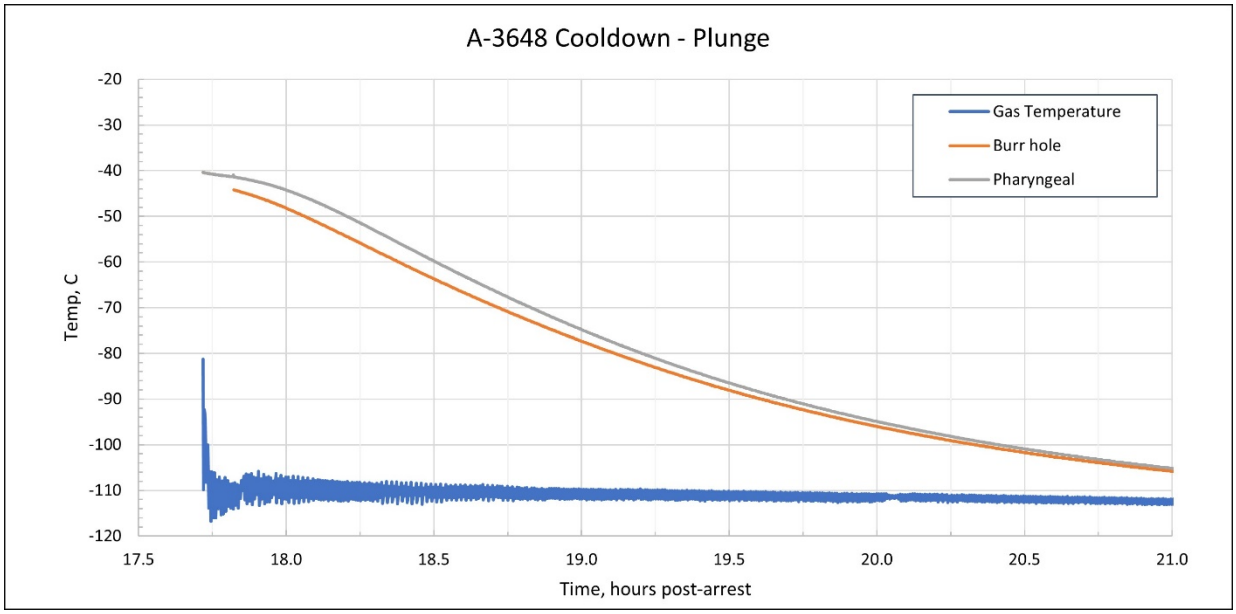
The vertebral arteries could not be found and, therefore, could not be cannulated. It is not always possible to find the vertebral arteries, but because in some patients they are important for completion of the Circle of Willis, and, therefore, for whole brain perfusion, the DART members have been given additional surgical training in how to find and cannulate these vessels.

The MSV needs a better ventilation system to prevent toxic air pollution from the perfusate. The ventilator alarms are not well understood by all DART members. The MSV ventilator emits different sounds for various issues. The ventilators are being replaced with other equipment and the DART members will receive in-depth training on the new ventilators.

14. Cryoprotection and Temperature Graphs







15. S-MIX

Datalogger temperature data was not collected and so S-MIX is not calculated for this case.

16. CT Scans

Cryoprotectant Distribution (Post-cryopreservation CT scan)

When the in-house scanner is functional and patients are being scanned, additional information will be added to this report.