Alcor A-2791

Case Report

LIFE EXTENSION FOUNDATION
The World's Leader in Cryonics
www.alcor.org

Prepared by:

Linda Chamberlain, Co-Founder and Director of Special Projects, Alcor Life Extension Foundation

December – 2023

Table of Contents

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-2791 was a 69-year-old member with neuro cryopreservation arrangements. The member was not on the Watch List, but Alcor was called when the member suffered a possible stroke. Cardiac arrest occurred 17:29 hrs on T-0 days and the member was pronounced legally deceased in California at 17:35 hrs on T-0 days in 2023.

After Field Cryoprotection (FCP), the patient was air transported to Alcor for cryogenic cooldown. The patient arrived at Alcor at 21:03 hrs on T+1 days. The cryogenic cooldown was initiated on T+1 days at 21:27 hrs and terminated on T+6 days at 18:33 hrs. The patient was transferred to long-term care at liquid nitrogen temperature on T+42 days at 13:32 hrs.

2. Patient Assessment and Deployment

T-6 days

A member's Medical Power of Attorney (MPOA) called Alcor's medical answering service at 07:24 hrs to report the member being in the hospital with what may have been a stroke. Alcor's Medical Response Director (MRD) immediately contacted the hospital for the member's status and was waiting to be called back. At 09:04 hrs the hospital called the MRD to report that they would not give information to Alcor until they could identify the member's Medical Power of Attorney (MPOA).

At 10:20 hrs the MRD received an e-mail from the member's MPOA that had been sent only to the member's friends the evening prior. It stated that the member had refused all medications for more than a week (which was not unusual according to the member's friend). The member's physician had told the MPOA that the member had another stroke and a heart attack the day before. The primary reason for hospitalization was continuous seizures. The MRD had called the Intensive Care Unit (ICU) six times with no success in gaining information. At 15:45 hrs the MRD received a thorough nursing update.

Mental status: the member had presented with active seizures, which had started at approximately 13:00 hrs the day before. A neuro CT scan showed growing edema. The member had experienced an occlusion of the left internal carotid artery from atherosclerosis. An EEG was ordered, but the results could not be found. Cardiac status: blood tests indicated that a heart attack had occurred. Renal status: blood tests indicated slightly elevated renal function.

The member's vital signs were temperature (T) 37.3°C, heart rate (HR) 82/min, respiratory rate (RR) 20, blood pressure (BP) 146/75, mean arterial pressure (MAP) 97, the capillary oxygen saturation (SpO2) was 99% ventilated on PRVC FiO2 35% PEEP 5 RR 20 Vt 450. The member was being given Levophed, a vasoconstrictor, and propofol for seizure prevention.

The Deployment Committee agreed that a Level-1 Deployment should be immediate and that this case would be done as a Field Cryoprotection (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 team usually contracted for FCP cases was not available for deployment. The MRD called the team leader of Suspended Animation (SA) in California, another of Alcor's strategic partners for providing standby, stabilization, and transport (SST) as well as remote blood substitution. This was not a blood substitution case, but the team leader agreed to personally assist Alcor personnel with this case, bring his portable ice bath (PIB) so that Alcor's would not need to be shipped, and to rent a minivan for the case. Both the Alcor Medical Response Director (MRD) and the Social Services Director (SSD) were also deployed.

3. Standby

T-5 days

The MRD and SSD had arrived in California and checked in to a hotel 11 minutes away from the hospital and 4 minutes away from the contracted funeral home. The MRD reported at 17:00 hrs they had a productive conversation with the entire medical team, the member's MPOA, the hospital social worker, and another friend of the member who was listed in the Advanced Directive as a back-up decision-maker to the MPOA.

The medical team had good questions regarding cryopreservation in general and the logistics of the procedures the team would use. It was not yet possible to obtain a decision on what the team would be allowed to do inside the hospital, as they needed to take the information to their risk management department. The general consensus was that it was not yet time for the MPOA to make the decision to transition to comfort care.

At 21:44 hrs the member would withdraw from painful stimuli. The vital signs were BP 120/57, MAP 80, HR 104, RR 20, T 38.5°C (38°C after Tylenol), SpO2 was 97% ventilated on PRVC FiO2 25%, PEEP 5, RR 20, Vt 450. The member had experienced tachycardia arrhythmia, an abnormally fast heartbeat, a couple of times throughout the day which was corrected with an Amiodarone bolus. The member was no longer being given Levophed. Urine output had decreased, indicating a further progression of acute kidney failure.

T-4 days

The hospital had started tube feeding the member. Other than that, there were no signs of improvement, however, they still did not think it was time for the MPOA to decide to remove care.

T-3 days

Because this was Friday, the social worker prefilled the Release of Human Remains form. Alcor was confirmed as acting as the proxy of the funeral home in order to take possession and start patient transport to the funeral home.

T-2 days

Nothing to note on this day.

T-1 days

The MPOA spoke to the hospital administrator and the member's physician, and the plan was to transition to comfort care the following morning at 09:00 hrs. Alcor would not be allowed in the building until the member was pronounced legally deceased.

T-0 days

The MRD learned at 09:49 hrs that the attending physician planned to extubate the member within the next hour. The team was stationed outside the hospital near the ambulance bay waiting for further instructions. At 11:22 hrs the member was extubated. The hospital allowed the team to park at the entrance with the most direct access to and from the ICU and to station the stabilization equipment in a break room for faster access to the member.

At 17:10 hrs the team was instructed to leave the hospital due to the physician leaving for the day and that was his instruction. The team was, however, permitted to stage the PIB and other stabilization equipment in the member's room prior to leaving the facility. The charge nurse called the MRD to notify the team that the member was declining rapidly. The team returned to the ICU at 17:29 hrs for an update. The member's heartbeat could not be detected, and other vital signs were extremely faint, but still present. The hospital personnel were standing by to pronounce legal death.

4. Standby and Stabilization

Hospital personnel pronounced the patient legally deceased at 17:35 hrs. At 17:40 hrs the team arrived in the patient's room and prepared to transfer the patient to the PIB. The attending physician intervened and informed the team that he would not allow the team in the room or to touch the patient until the medical examiner had signed off. The nurses and doctors were not able to reach the medical examiner at that time.

At 17:45 hrs Alcor's legal counsel was called and updated, but since it was after hours it was felt that little could be accomplished until the next day. The medical examiner did call the hospital and at 18:21 hrs and the team was allowed in the patient's room to start stabilization procedures. The patient was moved at 18:25 hrs to the PIB which had been prepared with water and ice to start external cooling. As there were five team members many of the stabilization procedures were performed concurrently.

An intraosseous device (IO) was placed in the tibial tuberosity of the patient's right leg at 18:26 hrs for access to the patient's vasculature for the administration of stabilization medications. Administration of stabilization medications was started at 18:26 hrs (see the below Table of Medications Administered for the names of the medications, dosages, and times of

administration). A second IO was placed in the tibial tuberosity of the patient's left leg at 18:27 hrs to speed the administration of medications.

An additional 40 lbs. of water ice was added to the PIB at 18:27 hrs. The surface conduction cooling device (SCCD) was started at 18:27 hrs to circulate ice water around the patient and improve external cooling. The King airway was placed at 18:27 hrs to restore ventilation and the CMI-9008 capnograph device was attached at 18:28 hrs to measure the partial pressure of carbon dioxide in the exhaled breath expressed as CO2 concentration over time. The Rosc-U mechanical chest compression device was placed. After about one minute of trouble shooting to get it started, the device was started at 18:28 hrs to circulate the medications and to improve cooling.

The capnograph device indicated that intubation had not been done properly. The patient was reintubated at 18:30 hrs (see the capnograph data graph). The gastric tube was placed at 18:32 hrs for the administration of antacid into the stomach. The nasopharyngeal thermocouple (NPT) was placed at 18:33 hrs. At 18:39 hrs the right NPT was 28°C and the left NPT was 34°C. After completion of medication administration, the patient was moved to the transport vehicle and departed the hospital at 18:46 hrs. The patient arrived at the funeral home at 18:52 hrs.

5. Field Surgery and Cryoprotectant Perfusion

The patient was moved to the operating table in the funeral home. Cardiopulmonary support was discontinued at approximately 19:10 hrs to allow surgery to begin. The NPT was 18.95°C. While the patient was still cooling in the PIB, surgery was initiated at 19:13 hrs with a left lateral incision for carotid cutdown. The left carotid artery was isolated at 19:26 hrs and cannulated with an 18 French (Fr) right angle cannula at 19:30 hrs. 25,000 IU of streptokinase, a thrombolytic used to break up existing blood clots, was added to the first bladder #2, the first bladder to be used for cryoprotectant perfusion. Bladder #1 containing B1 carrier solution was used to prime the circuit tubing.

The gravity-induced cryoprotectant perfusion was initiated at 19:33 hrs with Bladder #2 containing nM22 cryoprotectant with a concentration of 0.05% needed to vitrify (CNV). See the below Table of Concentrations (Brix) of nM22 Solution for the precalculated refractive index of the individual bladders, times when the bladders were started, and the refractive index of the effluent samples.

The height of the bladders on the teeter-totter was not recorded (no measuring tape was available, see the Discussion section) in order to calculate 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 protection of the vasculature (see Discussion section for more information on the gravity induced perfusion system).

The left jugular vein was severed at 19:34 hrs to allow open circuit perfusion. The right lateral incision was made for the carotid cutdown at 19:38 hrs. The right carotid artery was isolated at 19:45 hrs and cannulated at 19:48 hrs with an 18 French (Fr) right angle cannula. Perfusion was started on the right carotid artery at 19:50 hrs. The pressure remained unchanged. The right jugular vein was severed 19:51 hrs.

The burr hole for the brain temperature thermocouple was started at 19:50 hrs and completed at 19:57 hrs. The thermocouple was inserted and secured. The cephalic isolation procedure was initiated at 19:58 hrs. The spinal cord was severed using an osteotome and mallet. The procedure was completed at 20:13 hrs. Bilateral vertebral artery cannulation was initiated at 20:16 hrs. Bilateral vertebral artery cannulation was completed at 20:18 hrs.

The patient's cannulae were connected to the FCP circuit tubing at 20:23 hrs. Ethylene glycol antifreeze was added to the water in the heat exchanger at approximately 21:00 hrs to produce temperatures below 0°C. The 30-minute pause for patient equilibrium (bladder #6 and #7) was started at 21:05 hrs with a refractive index (RI) reading from effluent from the jugular veins at 25.6 Brix (39% of perfusate concentration needed to vitrify (CNV). The pause was terminated at 21:35 hrs with an RI from effluent at 41.5 Brix (79% CNV). Field cryoprotectant perfusion was terminated at 23:01 hrs. The final effluent refractive index reading was 50.0 Brix (100% CNV).

The patient was transferred to the neuro shipper and covered with 10 lbs. of dry ice at 23:15 hrs.

6. Patient Transport

T+1 days

The patient was moved to the transport vehicle at 00:45 hrs while the team waited for the patient's nasopharyngeal temperature (NPT) to fall to that of dry ice (-80°C). At 01:05 hrs the patient's NPT was -80°C and 5 lbs. of dry ice were added to the shipper.

The patient was delivered at the cargo department of a local airport at 12:53 hrs. The flight was delayed because of the weather and did not take off until 16:57 hrs. The SSD flew with the patient. The patient arrived at Alcor at 21:03 hrs. The nasopharyngeal temperature (NPT) was -82.7°C and the burr hole temperature (BHT) was -85.7°C.

7. Cooling to Liquid Nitrogen Temperature

Computerized cryogenic cooldown was started 21:27 hrs on T+1 days, plunging to -110°C and descending thereafter at -1°C/hour to liquid nitrogen temperature. On T+6 days at 18:33 hrs, an uneventful cooldown was terminated. On T+42 days, the patient was transferred to long-term care at liquid nitrogen temperature.

8. Timeline and Time Summaries

Timeline

T-0	17:29	Estimated time of cardiac arrest
T-0	17:35	Pronouncement of legal death
T-0	18:25	Start of ice bath cooling
T-0	18:26	Placement of right intraosseous device
T-0	18:26	Administration of first medication (propofol)
T-0	18:27	Placement of left intraosseous device
T-0	18:28	Start of mechanical chest compressions
T-0	18:28	Placement of airway and capnograph
T-0	18:35	Administration of final medication (decaglycerol/THAM)
T-0	18:46	Start transport of patient to mortuary (for surgery and FCP)
T-0	18:52	Arrive at funeral home
T-0	19:10	Estimated end of cardiopulmonary support (18.95°C)
T-0	19:13	Start of field surgery
T-0	19:50	Start burr holes
T-0	19:57	End burr holes
T-0	19:58	Estimated start of cephalic isolation
T-0	20:13	End of field surgery, completed cephalic isolation
T-0	20:23	Start of open circuit cryoprotection (FCP)
T-0	21:05	Start 30-minute pause for equilibration (bladders #6 and #7)
T-0	23:01	End of open circuit cryoprotection (final BRIX 50.0)
T-0	23:15	Start of dry ice cooling
T+1	00:45	Departure of patient from funeral home
T+1	00:53	Arrival of patient at cargo dept/airport
T+1	01:05	Dry ice temperature achieved
T+1	16:57	Departure of flight
T+1	21:03	Arrival of patient at Alcor (NPT 82.7-°C, BHT -85.7°C)
T+1	21:27	Start of patient cryogenic cooldown
T+6	18:33	End of cooldown
T+42	13:32	Transfer of patient to long-term care at LN2 temperature

Time Summaries

Event Duration hr:min		days	time	
Stabilization				
00:06	From:	T-0	17:29	Estimated time of cardiac arrest
	Till:	T-0	17:35	Pronouncement of legal death
00:56	From:	T-0	17:29	Estimated time of cardiac arrest
	Till:	T-0	18:25	Start of ice bath cooling
00:59	From:	T-0	17:29	Estimated time of cardiac arrest
	Till:	T-0	18:28	Start of mechanical chest compressions
00:57	From:	T-0	17:29	Estimated time of cardiac arrest
	Till:	T-0	18:26	Administration of first medication (propofol)
00:09	From:	T-0	18:26	Administration of first medication (propofol)
	Till:	T-0	18:35	Administration of final medication (decaglycerol/THAM)
Field Surgery and Cryoprotection (FCP)				
01:44	From:	T-0	17:29	Estimated time of cardiac arrest
	Till:	T-0	19:13	Start of field surgery
01:00	From:	T-0	19:13	Start of field surgery
	Till:	T-0	20:13	End of field surgery, completed cephalic isolation
02:54	From:	T-0	17:29	Estimated time of cardiac arrest
	Till:	T-0	20:23	Start of open circuit cryoprotection (FCP)
02:38	From:	T-0	20:23	Start of open circuit cryoprotection (FCP)
	Till:	T-0	23:01	End of open circuit FCP (final BRIX 50.0)
05:32	From:	T-0	17:29	Estimated time of cardiac arrest
	Till:	T-0	23:01	End of open circuit FCP (final BRIX 50.0)
01:00	From:	T-0	19:13	Start of field surgery
	Till:	T-0	20:13	End of field surgery, completed cephalic isolation
01:10	From:	T-0	19:13	Start of field surgery
	Till:	T-0	20:23	Start of open circuit cryoprotection (FCP)
03:48	From:	T-0	19:13	Start of field surgery
	Till:	T-0	23:01	End of open circuit FCP (final BRIX 50.0)
Dry Ice and Liquid Nitrogen Cooldown				
00:14	From:	T-0	23:01	End of open circuit FCP (final BRIX 50.0)
	Till:	T-0	23:15	Start of dry ice cooling
05:46	From:	T-0	17:29	Estimated time of cardiac arrest
	Till:	T-0	23:15	Start of dry ice cooling
27:34	From:	T-0	17:29	Estimated time of cardiac arrest
	Till:	T+1	21:03	Arrival of patient at Alcor (NPT 82.7-°C, BHT -85.7°C)
00:24	From:	T+1	21:03	Arrival of patient at Alcor (NPT 82.7-°C, BHT -85.7°C)
	Till:	T+1	21:27	Start of patient cryogenic cooldown

9. Table of Medications Administered

T-0 days

TIME	MEDICATION	DOSE	PURPOSE
18:26 hrs	Propofol	200 mg	Anesthetic; reduces cerebral metabolic demand; reduces the theoretic possibility of increased awareness during aggressive CPS.
18:27 hrs	Sodium citrate	20 g Note 1	Anticoagulant; prevents blood clot formation.
18:27 hrs	Heparin	50,000 IU	Anticoagulant; prevents blood clot formation.
18:28 hrs	Vasopressin	40 IU Note 2	Vasopressor; increases blood pressure during CPS.
18:28 hrs	SMT (S-methyl-isothiourea)	400 mg Note 3	Neuroprotectant (iNOS inhibitor); protects the brain from ischemic injury; raises blood pressure.
18:29 hrs	Minocycline	200 mg	Antibiotic and neuroprotectant
18:30 hrs	Decaglycerol/THAM	100 cc Note 4	Decaglycerol inhibits cerebral edema.
18:34 hrs	Vital Oxy (w/ saline)	70 ml Note 5	Antioxidants: melatonin, vitamin E (D-alpha tocopherol), PBN (alpha Phenyl t-Butyl Nitrone) and anti-inflammatory carprofen.
18:35 hrs	Vasopressin	40 IU Note 2	Vasopressor; increases blood pressure during CPS.
18:35 hrs	Antacid	250 cc Note 6	A buffer used to protect the stomach from acid erosion.
18:35 hrs	Decaglycerol/THAM	100 cc Note 4	Decaglycerol inhibits cerebral edema.
19:33 hrs	Streptokinase	25,000 IU Note 7	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 104 kg.

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. It is a fixed dose of 200 ml.

5. 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.

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

7. With the abbreviated medications protocol, streptokinase is not administered with the stabilization medications but is put in the first batch of washout solution. The standard administration of streptokinase is 250,000 IU dissolved in 5 mL of 9% sodium chloride, and 25,000 IU for the abbreviated medications protocol. 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.

10. Table of Concentrations (Brix) of nM22 Solution

A-2791 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
2	0.05	0.47	11.81	19:33	1.97	133.3		19:33	14.8
3	0.08	0.78	13.14	19:48	2.22	117.6		20:05	19.6
4	0.14	1.29	15.35	20:05	2.50	76.9		20:49	25.6
5	0.23	2.15	19.03	20:31	2.93	111.1		21:05	30.8
6	0.50	4.67	29.85	20:49	3.23	125.0		21:29	41.5
7	0.50	4.67	29.85	21:05	3.50	83.3		21:58	43.4
8	1.06	9.91	52.306	21:29	3.90	69.0		22:20	49
9	1.06	9.91	52.306	21:58	4.38	90.9		22:34	49.5
10	1.06	9.91	52.306	22:20	4.75	142.9		22:47	49.7
11	1.06	9.91	52.306	22:34	4.98	153.8		23:01	50
12	1.06	9.91	52.306	22:47	5.20	142.9			
END				23:01	5.43				

* does not account for concentration of non-penetrating CPAs

Note: When the bladders with precalculated concentrations of cryoprotectant are made up in the lab, the first bladder in the series contains only the B1 carrier solution with no cryoprotectant and is intended to be used for purging air bubbles. Bladder #2 contains the lowest concentration of cryoprotectant. Limited experience with the bladder system, however, has shown that better edema control is provided when the initial perfusion is done with cryoprotectant. As a result,

cryoprotectant perfusion is initiated with Bladder #2. When there is sufficient experience to make this the standard protocol, the lab procedure for creating the bladders will be changed so that Bladder #1 will contain cryoprotectant.

11. Discussion

Field Surgery and Washout

The burr hole thermocouple was stapled to the patient's scalp to secure it, but the staples are meant for items of a larger diameter than our thermocouples, which are exceptionally fine because they are going into the burr hole at the brain. This is also true for the nasopharyngeal thermocouples. In the future, the thermocouples will be ligated for better security.

There were no Weitlaner retractors in the neuro surgical kit. These will be added.

The gravity feed system for FCP uses a tripod that can be adjusted for height to control the arterial pressure. The pre-mixed cryoprotectant was in a series of bladders with graduated concentrations [measured by the refractive index (RI) in Brix units]. The height of the bladders was not recorded as there was no measuring tape in the kit. An estimated height was called out for the video recording, but it could not be heard on the play back. The team has been instructed about the importance of measuring height in order to calculate pressure.

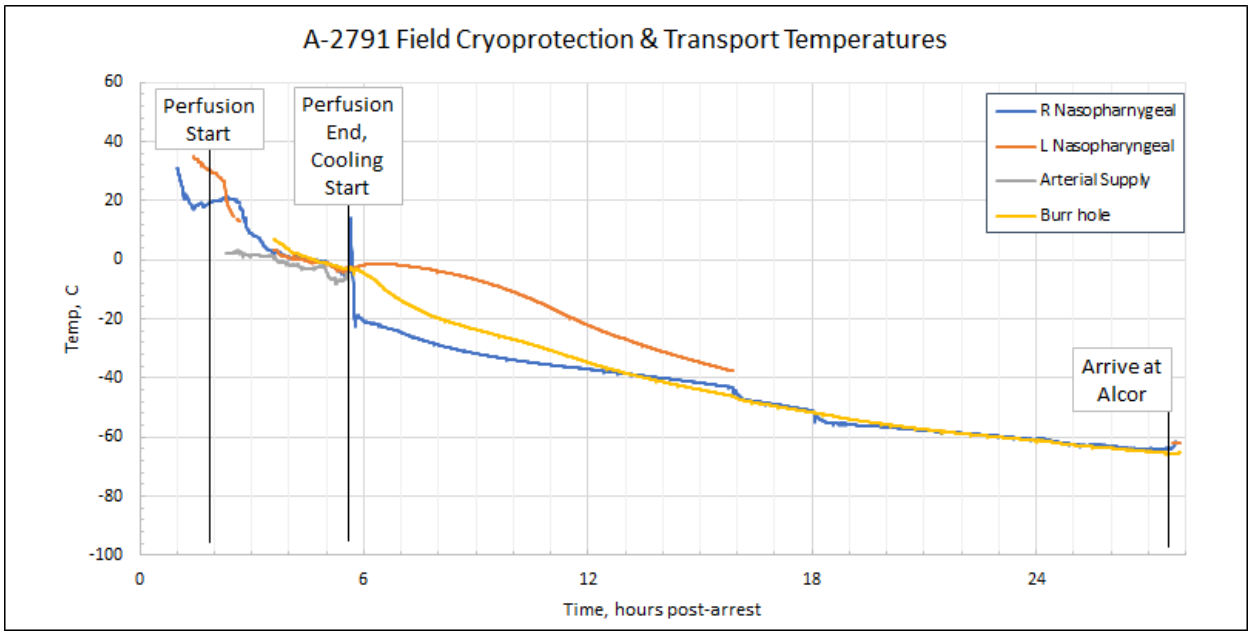
By hanging two bladders with different RI concentrations on a teeter-totter atop the tripod, the bladder with the lower RI runs out and becomes lighter. At the mid-way point, the teeter-totter will allow both bladders to flow, mixing the two concentrations and creating a smoother transition from one concentration to the next. When the bladder with the lower RI runs out, the full concentration of the bladder with higher RI is then flowing exclusively.

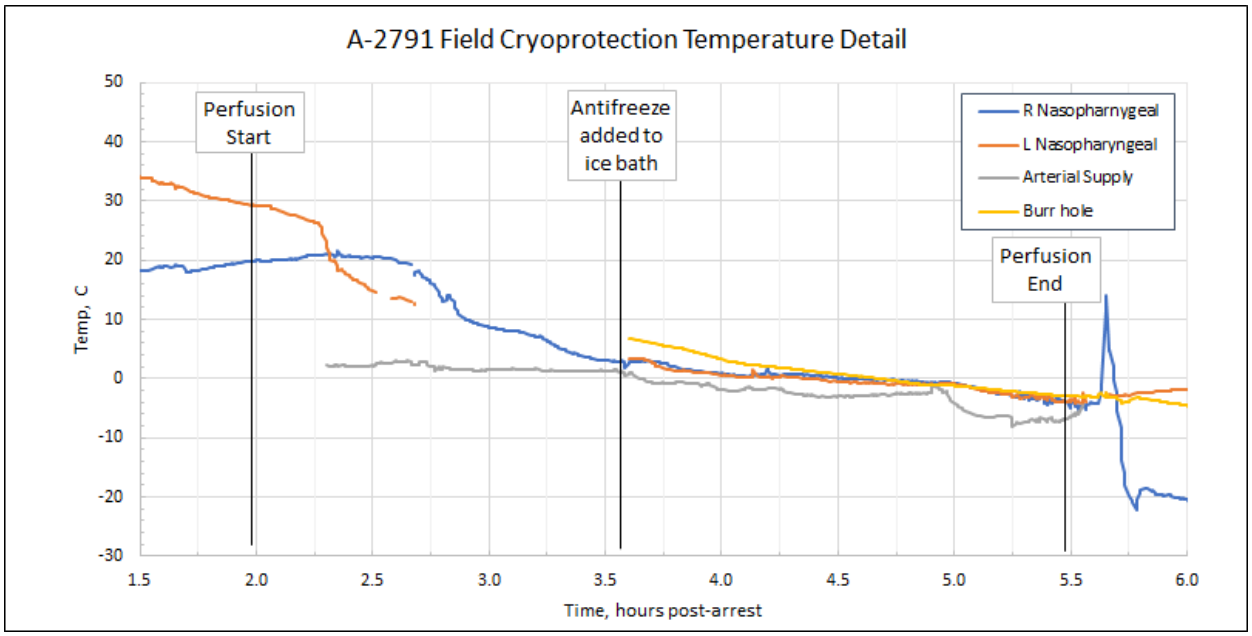
Patient Transport to Alcor

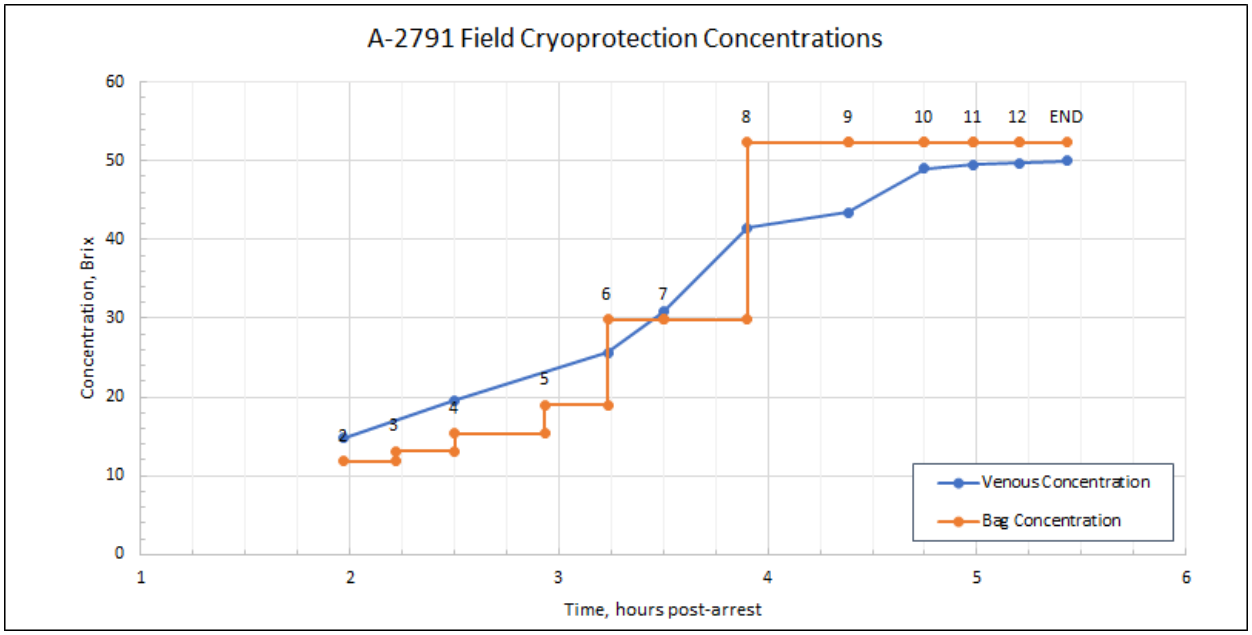
The current body bags are waterproof, but the top-zippers are not, allowing water to leak. Alcor will order some middle-zipper body bags to be used inside the top-zipper bags, in a double body bag approach. It is hoped that this will allow any leakage from the (inside) middle-zipper bags to be contained by the (outer) top-zipper bag.

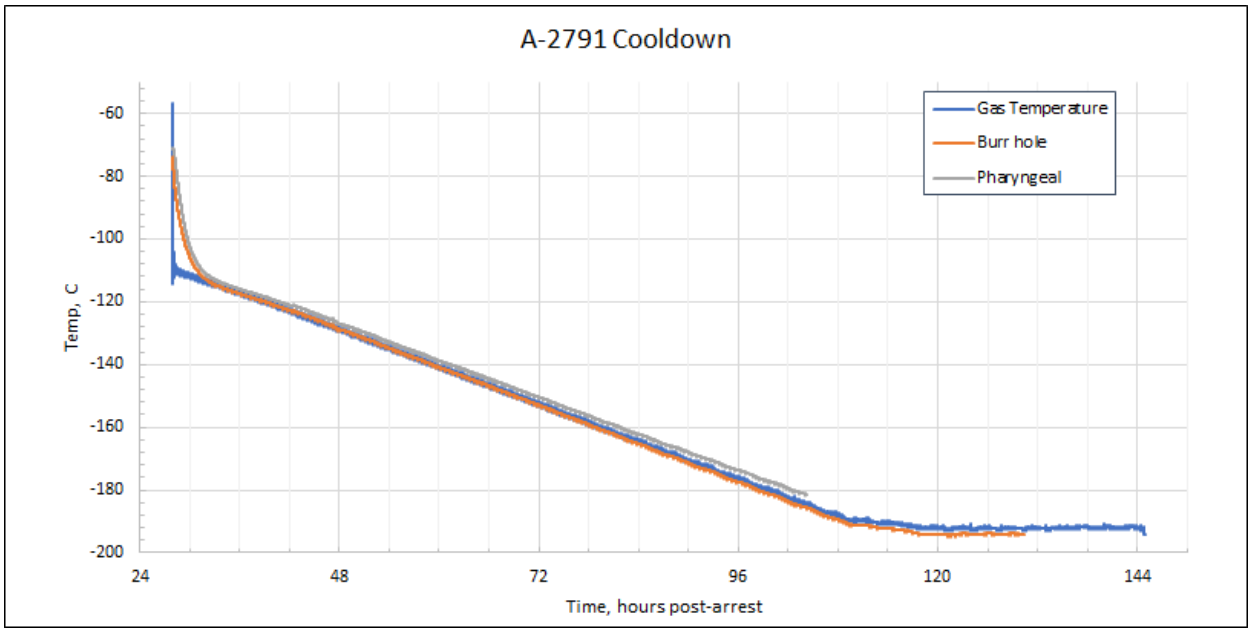
After the shipper was delivered to the cargo department at the local airport at 12:53 hrs, severe winds caused the flight to be delayed until 16:57 hrs. This is confirmation of the need to make sure dry ice, sufficient for such a delay, has been added to the shipper before being taken to the airport.

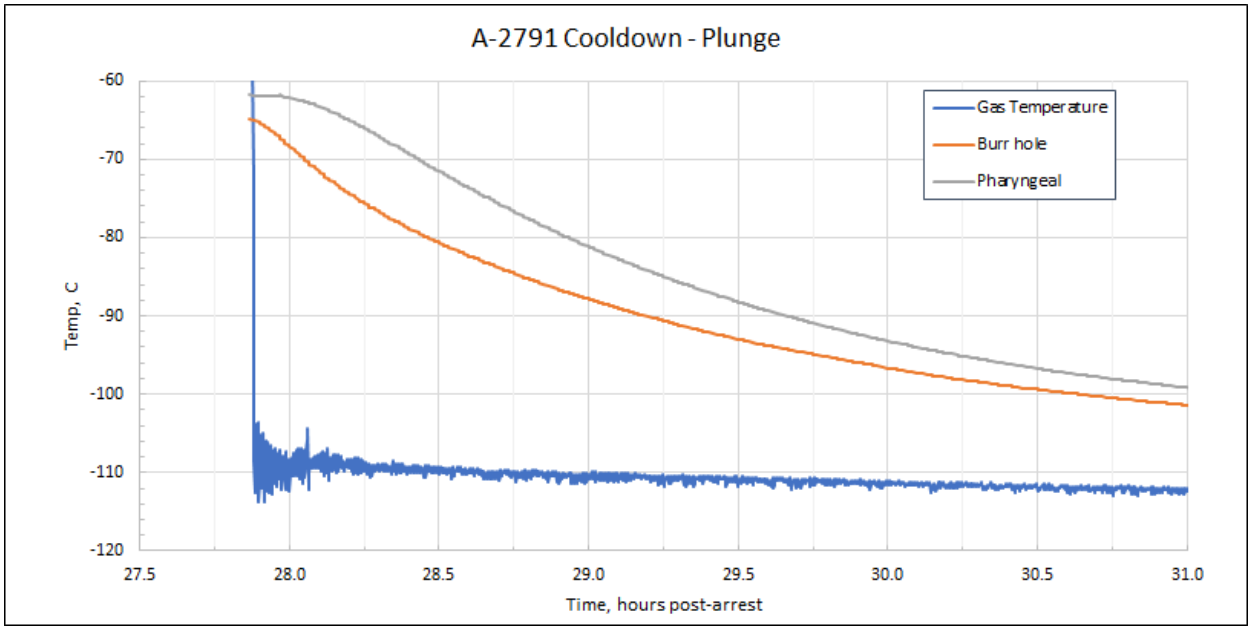
12. Cryoprotection and Temperature Graphs






A-2791 Field Cryoprotection Concentrations
Concentration, Brix
Time, hours post-arrest
Venous Concentration
Bag Concentration
2
3
4
5
6
7
8
9
10
11
12
END


A-2791 Cooldown
Temp, C
Time, hours post-arrest
Gas Temperature
Burr hole
Pharyngeal

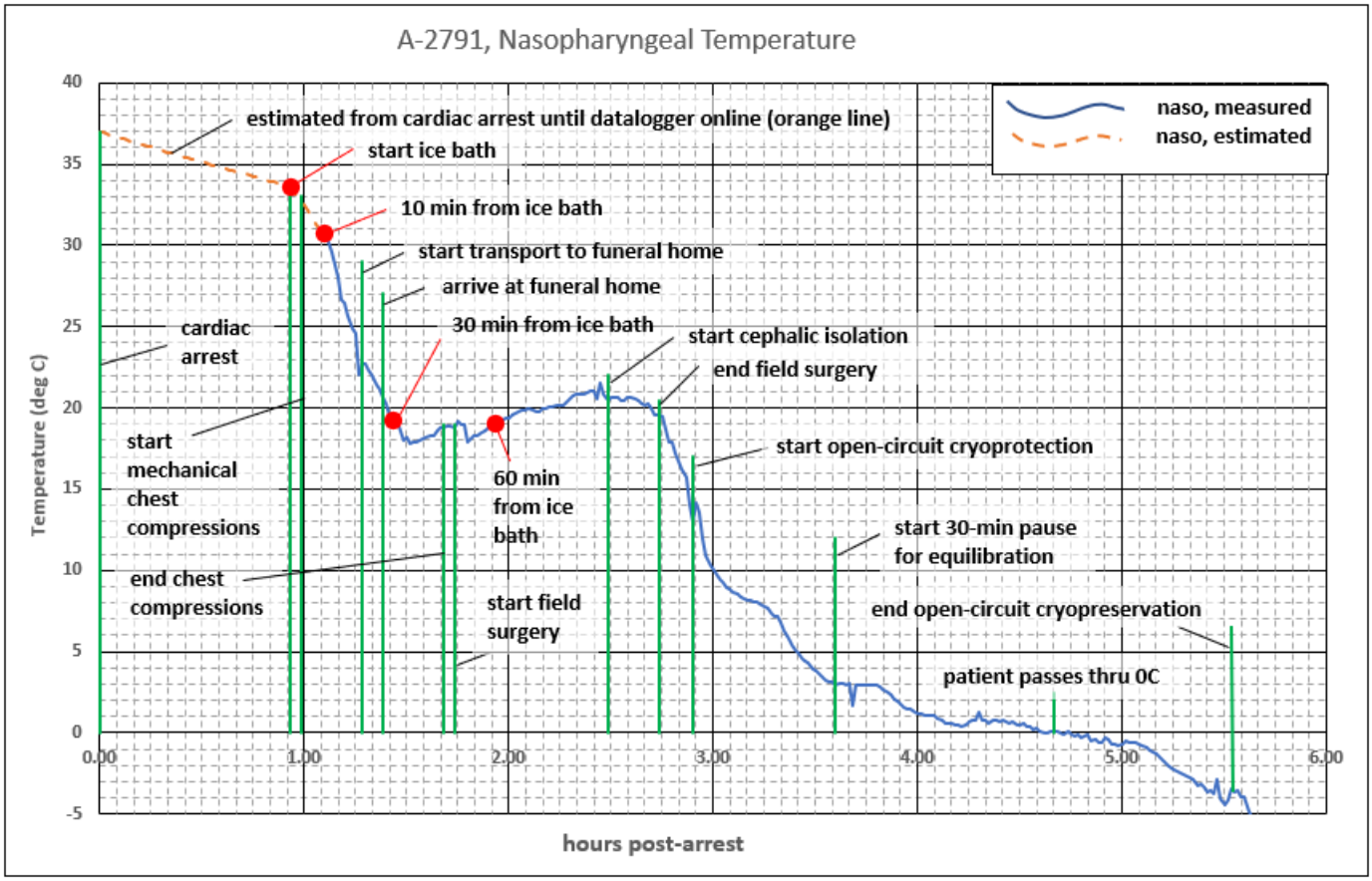

A-2791 Cooldown - Plunge
Gas Temperature
Burr hole
Pharyngeal
Temp, C
-60
-70
-80
-90
-100
-110
-120
27.5
28.0
28.5
29.0
29.5
30.0
30.5
31.0
Time, hours post-arrest

13. S-MIX

The Standardized Measure of Ischemic Exposure (S-MIX) expresses the total ischemic exposure prior to the start of cryogenic cooling as the equivalent duration of normothermic ischemia. An S-MIX of 00:00 (hh:mm) is the ideal case of no ischemic damage. The higher the S-MIX time, the more damage. Factors that improve the S-MIX, and that are quantitatively accounted for in the below table are: shorter times at higher temperatures, ventilation during cardiopulmonary support (CPS), and oxygenation during blood washout. The duration from cardiac arrest to 0°C is 4:40. As shown below, and due to lowering of the body temperature, S-MIX duration is shorter, at 01:33.

event	segment #	days (T+X)	time (MST) duration	post-arrest	Tnaso (deg C)	CPS w/ ventil.	washout oxygen.	S-MIX (hh:mm)
Estimated time of cardiac arrest		T-0	17:29	00:00	37.0			
	seg 1		00:56	00:56	-3.4	no	no	00:50
Start of ice bath cooling		T-0	18:25	00:56	33.6			
	seg 2		00:03	00:03	-0.9	no	no	00:02
Start of mechanical chest compressions & place airway		T-0	18:28	00:59	32.7			
	seg 3		00:18	00:18	-10.0	yes	no	00:05
Start transport of patient to funeral home		T-0	18:46	01:17	22.8			
	seg 4		00:06	00:06	-2.1	yes	no	00:01
Arrive at funeral home		T-0	18:52	01:23	20.7			
	seg 5		00:18	00:18	-1.9	yes	no	00:03
Estimated end of cardiopulmonary support		T-0	19:10	01:41	18.8			
	seg 6		00:03	00:03	0.0	no	no	00:01
Start of field surgery		T-0	19:13	01:44	18.8			
	seg 7		00:45	00:45	1.7	no	no	00:14
Estimated start of cephalic isolation		T-0	19:58	02:29	20.5			
	seg 8		00:15	00:15	-0.9	no	no	00:05
End of field surgery		T-0	20:13	02:44	19.5			
	seg 9		00:10	00:10	-6.6	no	no	00:03
Start of open circuit cryoprotection		T-0	20:23	02:54	13.0			
	seg 10		00:42	00:42	-10.0	no	no	00:05
Start 30-minute pause for equilibration		T-0	21:05	03:36	3.0			
	seg 11		01:04	01:04	-2.9	no	no	00:05
Patient passes thru 0C		T-0	22:09	04:40	0.1			
totals:			04:40	04:40	-37.0			01:33

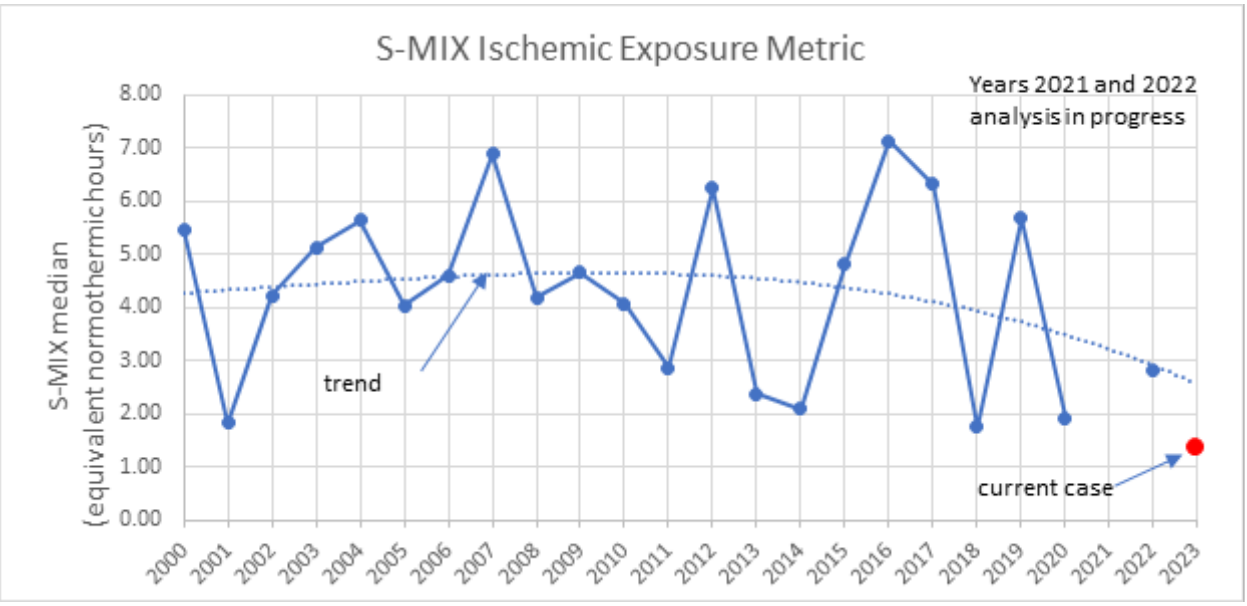
The below plot shows events related to the S-MIX calculation. The ice bath started prior to naso probe placement. The temperature at which the ice bath started is estimated such that the calculated $T_{INFINITY}$ (long-term equilibrium temperature) matches the room temperature of 10 C. The red dots can be used to construct a metric for how fast the patient is initially cooled (see the Patient Cooling Rate table below). This is a critical period since body temperature is highest and ischemic damage most rapid.



The below table provides cooling data for 10, 30, and 60 minutes after the team first applies water ice.

Patient Cooling Rate			(patient weight 104 kg; 229 lb)	
e: time = 0 at start of ice bath	0 min elapsed	10 min elapsed	30 min elapsed	60 min elapsed
Naso temperature (°C)	33.6	30.8	19.2	19.0
Temperature drop (°C) from t = 0	0.0	-2.9	-14.4	-14.6
Cooling rate (°C/min) from t = 0	N/A	-0.29	-0.48	-0.24

The following plot shows the trend of S-MIX achieved since 2000.



14. 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.