Alcor A-1141

Case Report

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-1141 was an 85-year-old member with neuro cryopreservation arrangements who had been in hospice care/assisted living for three months and had been on the MRD Watchlist since 2020. The member suffered from Parkinson's Dementia, leading to multi-organ failure. Cardiac arrest was estimated to be at 15:21 hrs on T-0 days and the member was pronounced legally deceased in Arizona at 15:23 hrs on T-0 days in 2023.

After stabilization, the patient was transported to Alcor for cryoprotection. The patient arrived at the Alcor operating room (OR) on T-0 days at 16:00 hrs. The cryogenic cooldown was initiated on T+0 days at 22:42 hrs and terminated on T+4 days at 18:27 hrs. The patient was transferred to long-term care at liquid nitrogen temperature on T+90 days at 14:43 hrs.

2. Patient Assessment and Deployment

T-2 days

This member had been on the Watch List for several months. The Alcor Medical Response Director (MRD) received a call at 12:07 hrs from an assisted living nurse that the member was actively dying, displaying labored breathing, unresponsiveness since the night before, pupils were dilated, and with periods of apnea lasting 10 seconds about every 30 minutes. The member was receiving morphine for pain management and Ativan for anxiety, as needed (dosages not recorded).

The Deployment Committee agreed at 12:08 hrs to deploy the home team for this Level-1 situation. Team members were notified and met at Alcor to prepare equipment. At 13:05 hrs the member's vital signs were: heart rate (HR) 125 beats/min (bpm), blood pressure (BP) 105/89, respiration rate (RR) 20/min, capillary oxygen saturation (SpO_2) 78% on room air.

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.

Half of the Alcor Team, consisting of five members, arrived at the member's medical facility at about 14:20 hrs. The member's vitals at 16:23 hrs were: BP 93/59, RR 44 bpm. HR 125/min, SpO2 80% on oxygen (O2) at 3L/min, and temperature (T) 39°C.

To be near the member, the team members were allowed to wait in a room down the hall from the member. The member's vitals at 23:07 hrs were: BP 70/44, HR 98 bpm, SpO_2 88% on 4 L/min, and RR 24/min. The team was moved to the room next door to the member to not only make it more convenient for the team, but also to cause less disturbance to the other residents of the facility.

T-1 days

The member's vital signs at 02:30 hrs were: BP 70/50, HR 93 bpm, SpO_2 89% on 4 L/min of O_2, and RR 24/min. At approximately 05:22 hrs the member's vitals were BP 57/45, HR 100 bpm, RR 32/min, and shallow, unable to obtain SpO_2 as the fingers were now too cold.

Neuro: The member was completely unresponsive with no movements, voluntary or otherwise. The member had been prescribed end of life comfort medications as follows: 0.25 mL morphine every 6 hours, 0.25 mL morphine every hour as needed, and Ativan 0.25 mL every hour as needed.

Cardiovascular: The pulse was weak (+1), the member was cold to the touch. Capillary refill was less than 3 seconds, and the lower extremities were mottled. The face, hands, and lips were very pale.

Pulmonary: Breathing had slowed to 18/min and was now shallow and irregular.

Gastrointestinal/Genitourinary (GI/GU): There had been no urine output overnight.

At 10:43 hrs the neuro perfusion system using bladders and the computer data collection system were confirmed to be set up in the Patient Care Bay at Alcor (see the Discussion section) and ready for the patient's arrival.

At 13:37 hrs the member's vital signs were: BP 70/46, HR 108 bpm, RR 28/min, SpO_2 (ear) 83% on 4 L/min of O_2, and T 36.6°C.

The vital signs were checked again at 17:00 hrs: BP 58/palp, meaning BP was too low to obtain a diastolic pressure number, HR rapid and thready, SpO_2 87% on room air (hospice took the member off oxygen as instructed by the family) but because the pulse rate was reading 36, the SpO_2 reading was likely not accurate. Breaths were rapid and shallow.

T-0 days

The member's vital signs 06:03 hrs were: BP 56/39, HR 112 bpm, RR 28/min, and SpO_2 73% on room air.

Neuro: The member was still unresponsive.

Cardiovascular: The pulse was weak and thready. The member was mottled in both the upper and lower extremities, around the pressure points. The SpO_2 was being read off the ear.
Pulmonary: Breathing was shallow and irregular, breath sounds diminished. The member had been off oxygen since T-1 days around 17:00 hrs.

GI/GU: There had been no urine output for 36 hours.

The member's vital signs 11:13 hrs were: BP 47/31, HR 116 bpm, RR 32/min, and SpO_2 63% on room air. The hands and feet were completely mottled, as well as the ankles, knees, and elbows. The pupils were unequal and non-reactive.

3. Stabilization

With five team members it was possible to accomplish many stabilization procedures simultaneously, finishing stabilization quickly. The member experienced cardiac arrest at 15:21 hrs and was pronounced legally deceased by the hospice nurse at 15:23 hrs. The member's nasopharyngeal temperature (NPT) was 19.2°C. The patient was moved into the portable ice bath (PIB) at 15:27 hrs and 100 lbs. of water ice was added to initiate external cooling. Manual chest compression were started at 15:28 hrs and the ROS-Q mechanical chest compression device was started at 15:30 hrs to improve cardiopulmonary support.

At 15:28 hrs an intraosseous (IO) device was placed in the tibial plateau of the left leg, but the needles did not advance so the IO was removed. A second IO was placed at 15:28 hrs in the tibial plateau of the right leg but the needles did not initially advance; however, the Medical Response Director (MRD) was able to advance the needle manually for proper function (see the Discussion section). A King airway with oropharyngeal tube (OPT) was placed at 15:30 hrs in order to ventilate the patient to minimize ischemic damage to the cells.

The first stabilization medication was administered at 15:29 hrs (see the below Table of Medications Administered for the names of the medications, the dosages, and the times of administration). At 15:43 hrs all of the stabilization medications had been administered. Three gallons of water were added to the ice bath to improve circulation of ice water around the patient.

4. Patient Transport

After completion of the stabilization procedure at 15:44 hrs, the Alcor rescue vehicle was used to transport the patient from the assisted living facility to Alcor for cryoprotectant perfusion and cryogenic cooldown. There were no complications or concerns during transport.

5. Cryoprotectant Perfusion Surgery

The patient arrived at the back door of Alcor at 16:02 hrs. The patient was covered with water ice in the portable ice bath (PIB) with the ROS-Q mechanical chest compression device running. The patient was brought into the Patient Care Bay which had been set up to carry out the surgery and perfusion at 16:07 hrs (see the Discussion section). The initial nasopharyngeal temperatures (NPTs) were 21.01°C in the left nare and 19.18°C in the right nare. Because no notice had been given to the OR staff that patient was enroute, the OR was still being organized.

Ice bags were removed from around the patient at 16:12 hrs. The patient was moved onto the OR table at 16:15 hrs. The data acquisition system was connected to the patient at 16:17 hrs. A thermocouple was placed in the left nare. The initial temperature reading was 21.01°C.

Styrofoam blocks were placed under the patient's shoulders at 16:37 hrs to raise the patient's head out of the ice for surgical access. More crushed ice was placed around the patient at 16:38 hrs. The NPT at 16:40 hrs was 18.0°C. Chest compressions were stopped at 16:44 hrs to prepare the patient for surgery, removal of the airway, and the datalogger lines.

The first cut for the cannulation surgery was made on the patient's neck at 16:48 hrs. The left carotid artery was isolated at 16:50 hrs and ligated at 16:51 hrs. The right carotid artery was isolated at 16:53 hrs and ligated at 16:54 hrs. Scalp cuts for the bilateral burr holes were made at 16:54 hrs.

A Codman craniotome fitted with a perforator bit was used to make the bilateral burr holes. Normal saline was poured over the drilling site to cool the bit and the patient's skull. Drilling the left burr hole was started at 16:55 hrs. A thermocouple was inserted in the left burr hole and secured by suturing the probe to the scalp at 16:57 hrs. The right burr hole temperature was 16.02°C at 17:00 hrs.

Perfusate bladders 2 and 3 were hung on the teeter-totter at 17:04 hrs to prepare for the perfusion procedure.

The cephalic isolation procedure was initiated at 17:05 hrs, clearing tissues from around the spine. The cephalic isolation was completed at 17:06 hrs using a spinal separation device to separate the spinal cord. The pre-perfusion weight of the cephalon was 4.99 kg at 17:07 hrs. The cephalon was placed into the neuro ring in the cephalic enclosure at 17:07 hrs to position it for surgery and perfusion.

Cannulation of the right carotid artery was started at 17:11 hrs with an 18 French (Fr) Red Robinson cannula and ligated in place. Right carotid cannulation was complete at 17:14 hrs.

6. Cryoprotectant Perfusion

To address patient edema, Bladder #1 was not used (see the note following the Table of Concentrations (Brix) below). Perfusion was initiated with the higher concentration of perfusate in Bladder #2. The gravity-induced cryoprotectant step ramp was initiated at 17:15 hrs with Bladder #2 containing nM22 cryoprotectant with a concentration of 0.05 concentration needed to vitrify (CNV) and a molarity of 0.47. See the 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 (see the Discussion section for a more detailed explanation of the field equipment). Effluent was flowing from the patient's mouth at 17:17 hrs. The arterial pressure was increased to 56 mmHg at 17:18 hrs.

Cannulation of left carotid artery was started at 17:20 hrs with an 18 Fr Red Robinson cannula and ligated in place. Both carotid cannulae were open to perfusion at 17:21 hrs. The arterial pressure was started at 50 mmHg and immediately increased to 69.5 mmHg.

At 17:24 hrs the patient temperatures were: arterial 2.4°C, burr hole 17°C, NPT 21°C. The arterial refractive index (RI) was 11.8 Brix.

Both jugular veins were raised at 17:32 hrs for placement of the refractive index (RI) sampling lines. The sampling lines were inserted at 17:38 hrs. The initial readings were: left sampling line at 10.6 Brix, right sampling line at 11.83 Brix. At 17:40 hrs the positions of equipment on the floor were adjusted to allow the surgeon to cannulate the left jugular vein. However, the left jugular RI reading could not be seen because it was blocked by equipment

in the small space (set up was in the patient care bay because of construction in the OR), so no samples would be taken from left jugular vein.

The vertebral arteries were draining, which confirmed that the Circle of Willis was intact and there would be reasonable perfusion pressure at the back of the brain. Cannulation of the right vertebral artery was attempted at 17:50 hrs. It was too small for cannulation and was clamped off. The left vertebral artery was cannulated at 17:56 hrs. Arterial pressure was increased to 72 mmHg at 18:04 hrs. The lid was placed on the cephalic enclosure at 18:05 hrs and the target temperature within the enclosure was set to 3°C. The target arterial pressure was raised to 84.5 mmHg at 18:12 hrs.

The right jugular sampling tube had no flow at 18:16 hrs, and air bubbles were being drawn into the sampling line. The arterial sampling pump speed was lowered from 19 to 14 to correct the problem. At 18:28 hrs it was noted that perfusion was slow due to edema in the patient (see the Discussion section).

At 18:41 hrs the right venous sampling line was too tightly secured, hampering the sampling flow rate. The line was adjusted, and flow improved. Normal tanning of facial skin from contact with the vitrification solution was noted at 18:55 hrs, and both corneas had become concave.

19:10 The right jugular sampling line was full of air again; bubbles were removed, and the problem corrected.

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 6 & 7 represent the pause. The cephalic/patient enclosure and the chiller are switched from +3°C to -3°C operation. 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.

Bladder #6 was started at 19:50 hrs and Bladder #7 was started at 19:59 hrs. The venous sampling line clogged, and samples were taken manually for the rest of the procedure. As the venous setup was not working properly at 20:09 hrs a manual RI sample was taken. The reading was 28.8 Brix.

At 22:01 hrs the refractive index (RI) of the effluent was 49.9 Brix. The 30-minute countdown to termination of cryoprotectant perfusion was started. Cryoprotectant perfusion was terminated at 22:31 hrs. The final RI concentration was 50.0 Brix.

The weight of the cephalon post-cryoprotectant perfusion was 4.41 kg at 22:32 hrs, representing a weight loss (shrinkage) of (4.99 – 4.41) 0.58 kg or 11.6 % weight loss.

7. Cooling to Liquid Nitrogen Temperature

All lines and equipment were removed from the patient, who was then placed in the cool-down dewar at 22:39 hrs.

Computer controlled cryogenic cooldown was initiated at 22:43 hrs on T-0 days, plunging to -110°C and descending thereafter at -1°C/hour to liquid nitrogen temperature. On T+4 days at 18:27 hrs, an uneventful cooldown was terminated. On T+90 days at 14:43 hrs, the patient was transferred to long-term care at liquid nitrogen temperature.

8. Timeline and Time Summaries

Timeline

T-0	15:21	Time of cardiac arrest
T-0	15:23	Pronouncement of legal death
T-0	15:27	Start ice bath cooling
T-0	15:28	Start manual chest compressions
T-0	15:30	Start mechanical chest compressions
T-0	15:28	Placement of first IO in left tibia (not patent)
T-0	15:28	Placement of second IO in right tibia
T-0	15:30	Placement of airway
T-0	15:29	Administration of first medication (propofol)
T-0	15:43	Administration of last medication (decaglycerol/THAM)
T-0	15:44	Start transport of patient to Alcor
T-0	16:07	Arrival of patient in OR at Alcor (19.2°C, right nare)
T-0	16:17	NPT probes attached to data acquisition system
T-0	16:44	Termination of cardiopulmonary support (NPT 18.0°C)
T-0	16:48	Start of surgery for cannulation and cephalic isolation
T-0	16:54	Start of burr hole surgery
T-0	16:56	Completion of (burr hole) surgery
T-0	17:05	Start of cephalic isolation
T-0	17:06	Completion of cephalic isolation
T-0	17:07	Weight of patient cephalon (4.99 kg)
T-0	17:14	Completion of cannulation (carotid, jugular, and vertebral)
T-0	17:15	Start of cryoprotectant ramp (bladders)
T-0	19:50	Pause for equilibrium at 50% of CNV achieved
T-0	22:01	Start 30-minute countdown to end of cryoprotection
T-0	22:31	Termination of cryoprotection (final Brix reading= 50.0)
T-0	22:32	Weight of patient cephalon after perfusion (4.41 kg)
T-0	22:42	Start of patient cryogenic cooldown
T+4	18:27	End of cooldown

Time Summaries

Event Duration hr:min		days	time	
STABILIZATION				
00:02	From:	T-0	15:21	Time of cardiac arrest
	Till:	T-0	15:23	Time of pronouncement of legal death
00:06	From:	T-0	15:21	Time of cardiac arrest
	Till:	T-0	15:27	Start ice bath cooling
00:07	From:	T-0	15:21	Time of cardiac arrest
	Till:	T-0	15:28	Start manual chest compressions
00:08	From:	T-0	15:21	Time of cardiac arrest
	Till:	T-0	15:29	Administration of first medication (propofol)
00:14	From:	T-0	15:29	Administration of first medication (propofol)
	Till:	T-0	15:43	Administration of last medication (decaglycderol/THAM)
00:46	From:	T-0	15:21	Time of cardiac arrest
	Till:	T-0	16:07	Arrival of patient in OR at Alcor (19.2°C, right nare)
CRYOPROTECTANT SURGERY AT ALCOR				
01:27	From:	T-0	15:21	Time of cardiac arrest
	Till:	T-0	16:48	Start of surgery for cannulation and cephalic isolation
00:26	From:	T-0	16:48	Start of surgery for cannulation and cephalic isolation
	Till:	T-0	17:14	Completion of cannulation (carotid, jugular, and vertebral)
01:54	From:	T-0	15:21	Time of cardiac arrest
	Till:	T-0	17:15	Start of cryoprotectant ramp (FCP)
05:16	From:	T-0	17:15	Start of cryoprotectant ramp (FCP)
	Till:	T-0	22:31	Termination of cryoprotection (final Brix reading= 50.0)
07:10	From:	T-0	15:21	Time of cardiac arrest
	Till:	T-0	22:31	Termination of cryoprotection (final Brix reading= 50.0)
CRYOPROTECTANT PERFUSION AT ALCOR				
01:54	From:	T-0	15:21	Time of cardiac arrest
	Till:	T-0	17:15	Start of cryoprotectant ramp (FCP)
01:08	From:	T-0	16:07	Arrival of patient in OR at Alcor (19.2°C, right nare)
	Till:	T-0	17:15	Start of cryoprotectant ramp (FCP)
00:27	From:	T-0	16:48	Start of surgery for cannulation and cephalic isolation
	Till:	T-0	17:15	Start of cryoprotectant ramp (FCP)
05:43	From:	T-0	16:48	Start of surgery for cannulation and cephalic isolation
	Till:	T-0	22:31	Termination of cryoprotection (final Brix reading= 50.0)
05:16	From:	T-0	17:15	Start of cryoprotectant ramp (FCP)
	Till:	T-0	22:31	Termination of cryoprotection (final Brix reading= 50.0)
CRYOGENIC COOLDOWN AT ALCOR				
00:12	From:	T-0	22:31	Termination of cryoprotection (final Brix reading= 50.0)
	Till:	T-0	22:43	Start of patient cryogenic cooldown
07:22	From:	T-0	15:21	Time of cardiac arrest
	Till:	T-0	22:43	Start of patient cryogenic cooldown
05:55	From:	T-0	16:48	Start of surgery for cannulation and cephalic isolation
	Till:	T-0	22:43	Start of patient cryogenic cooldown

9. Table of Medications Administered

T-0 days

TIME	MEDICATION	DOSE	PURPOSE
15:29 hrs	Propofol	200 mg	Anesthetic; reduces cerebral metabolic demand; reduces the theoretic possibility of increased awareness during aggressive CPS.
15:33 hrs	Sodium citrate	20 g Note 1	Anticoagulant; prevents blood clot formation.
15:33 hrs	Heparin	50,000 IU	Anticoagulant; prevents blood clot formation.
15:33 hrs	Vasopressin	80 IU total (1st dose 40 IU) Note 2	Vasopressor; increases blood pressure during CPS.
15:36 hrs	Minocycline	200 mg	Antibiotic and neuroprotectant
15:38 hrs	Antacid	250 cc total Note 3	A buffer used to protect the stomach from acid erosion.
15:41 hrs	SMT (S-methyl-isothiourea)	400 mg Note 4	Neuroprotectant (iNOS inhibitor); protects the brain from ischemic injury; raises blood pressure.
15:43 hrs	Decaglycerol/THAM	400 cc total (1st dose 200 cc) Note 5	Decaglycerol inhibits cerebral edema.
15:43 hrs	Vital Oxy (w/ saline)	60 mL total Note 6	Antioxidants: melatonin, vitamin E (D-alpha tocopherol), PBN (alpha Phenyl t-Butyl Nitrone) and anti-inflammatory carprofen.
15:43 hrs	Vasopressin	80 IU total (2nd dose 40 IU) Note 2	Vasopressor; increases blood pressure during CPS.
15:43 hrs	Decaglycerol/THAM	400 cc total (2nd dose 200 cc) Note 5	Decaglycerol inhibits cerebral edema.

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.

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

4. 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.

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). It is a fixed dose of 200 ml.

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.

10. Table of Concentrations (Brix) of nM22 Solution

A-1141 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
2	0.05	0.47	11.81	17:12	1.85	50.0
3	0.08	0.78	13.14	17:52	2.52	45.5
4	0.14	1.29	15.35	18:36	3.25	60.6
5	0.23	2.15	19.03	19:09	3.80	80.0
6	0.50	4.67	29.85	19:34	4.22	80.0
7	0.50	4.67	29.85	19:59	4.63	62.5
8	1.06	9.91	52.306	20:31	5.17	40.0
9	1.06	9.91	52.306	21:21	6.00	52.6
10	1.06	9.91	52.306	21:59	6.63	62.5
END				22:31	7.17	

* does not account for concentration of non-penetrating CPAs

Sample time hh:mm, MST	Effluent Conc., Brix
18:59	10.8
19:43	14.8
20:09	27.9
20:20	28.8
20:42	34.7
20:56	43.2
21:06	45
21:13	46.5
21:22	46.3
21:23	46.1
21:30	49.4
21:37	49.5
21:42	49.6
21:52	49.8

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 was 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

Standby and Stabilization

When the patient was pronounced legally deceased it was noted that the pupils were not dilated equally. This, unfortunately, is something that is seen in patients with extremely low blood pressure over several days and ultimately leads to brain damage. An increase in cryoprotectant concentration early in the process improved overall flow for much of the perfusion.

During the initial stabilization procedures an intraosseous (IO) Bone Injection Gun (BIG) was placed in the left leg, but the needle did not advance to allow medications to be administered. A second IO was placed in the right leg with the same result. The Medical Response Director (MRD) was able to advance the needle manually into the proper position. As a result, the MRD has replaced the BIG devices in Alcor's kits with the EasyIO drill, which is more efficient and causes fewer user errors.

There was an issue with the filter used prior to administering Minocycline, causing the administration of that medication to take 3 minutes. Going forward, filters will be checked prior to need for use (i.e., while waiting for pronouncement).

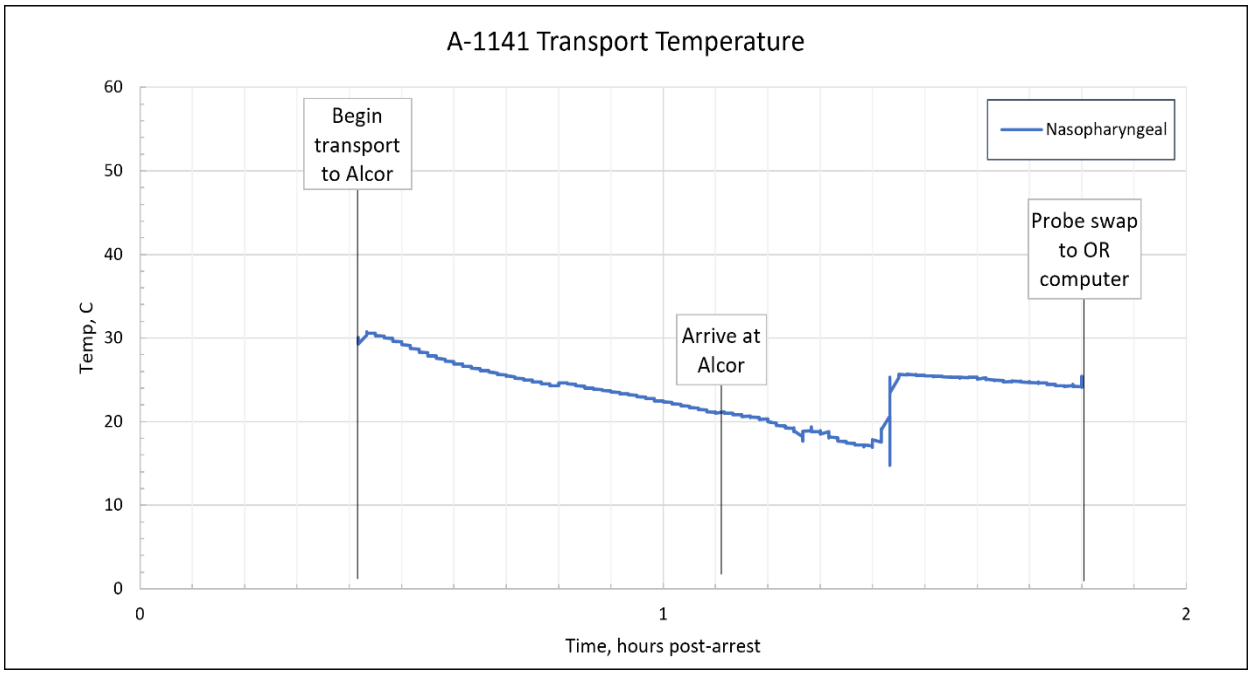
Cryoprotectant Surgery and Perfusion at Alcor

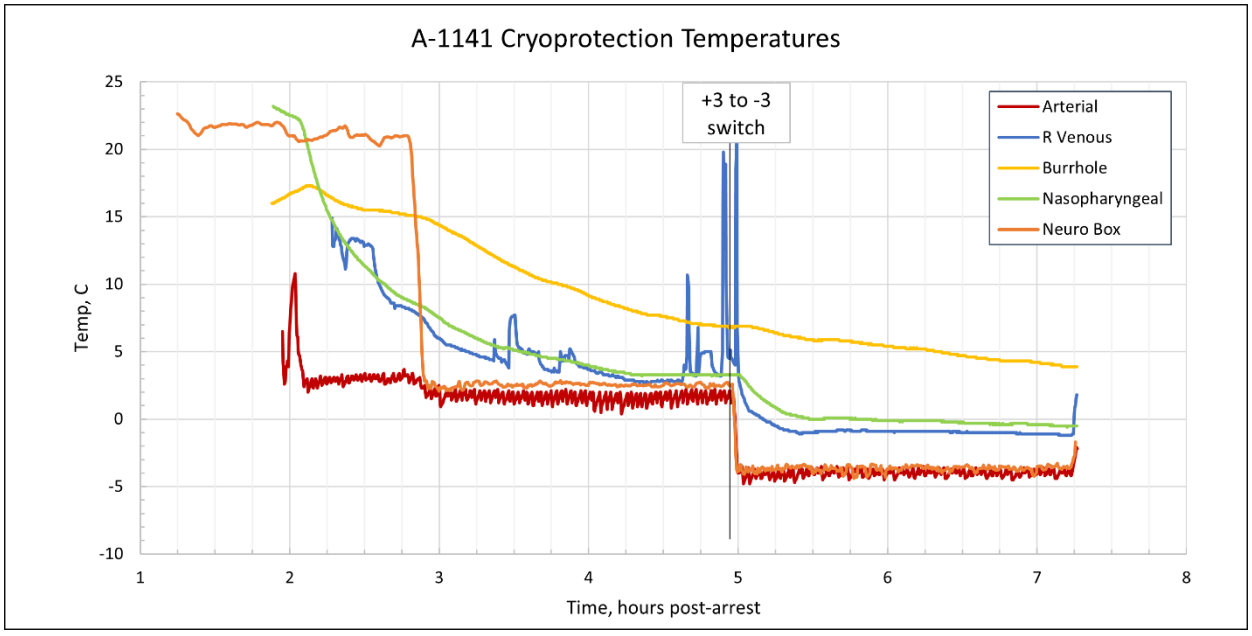
At the time of this case, construction in the Alcor operating room (OR) was under way for the new CT scanner, rendering the OR unusable. The OR data collection system and the field neuro cryoprotection system with a teeter-totter and bladders with pre-calculated concentrations of cryoprotectant were set up in the patient care bay, allowing for normal operating procedures to take place.

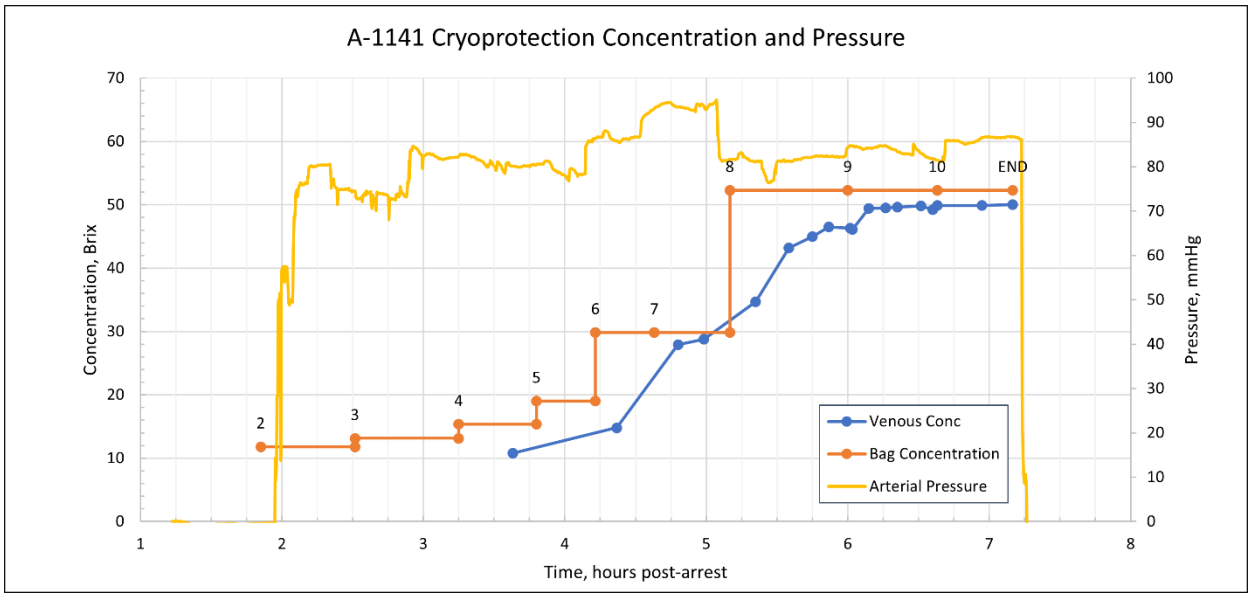
It is protocol to add 250,000 IU of streptokinase, a thrombolytic used to break up existing blood clots, to the first bladder to be used for cryoprotectant perfusion. This did not happen. The OR perfusionists are not accustomed to participating in cryoprotection using the bladder system and this was missed. During the debrief meeting for this case, this issue was raised so that all team members are aware of this for future cases.

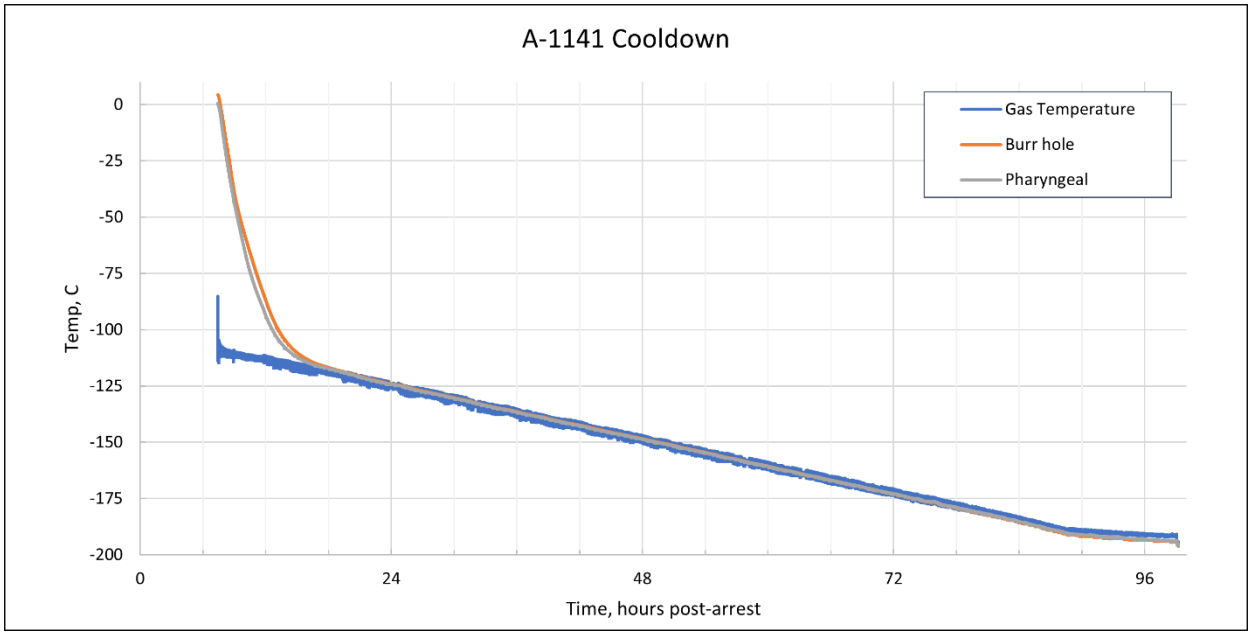
The right jugular sampling tube had no flow at 18:16 hrs. This may have merely been an issue with individual anatomy/physiology. AT 18:28 hrs it was noted that perfusion was slow due to edema in the patient.

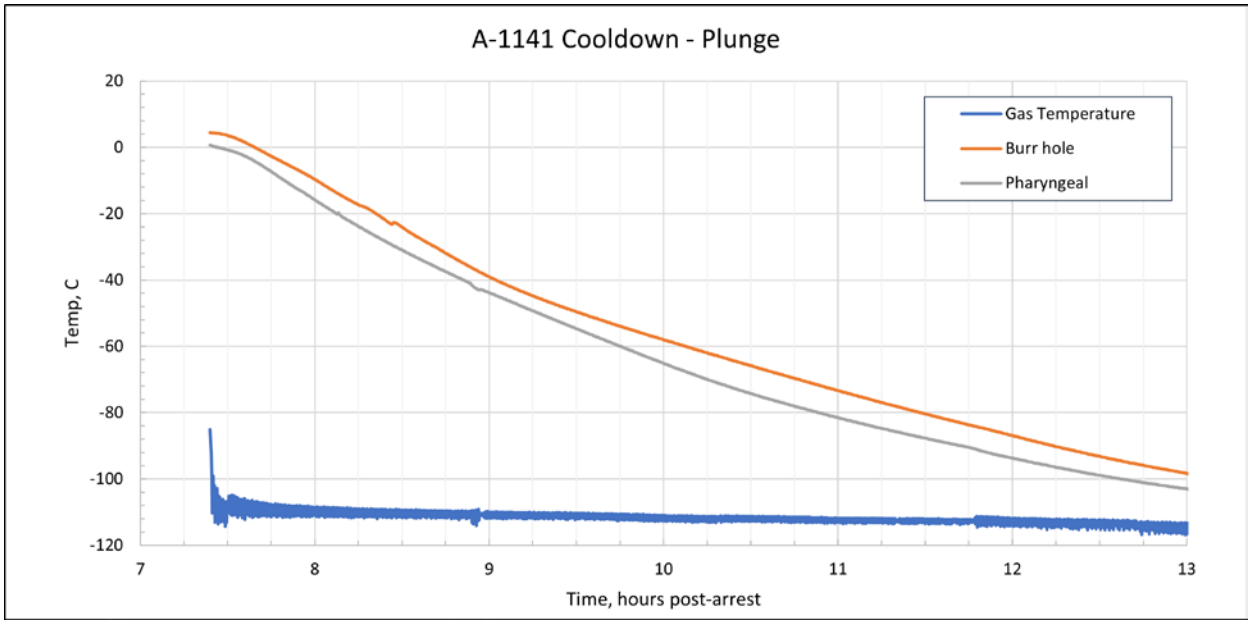
12. Cryoprotection and Temperature Graphs






A-1141 Cryoprotection Concentration and Pressure
Concentration, Brix
Pressure, mmHg
Time, hours post-arrest
2
3
4
5
6
7
8
9
10
END
Venous Conc
Bag Concentration
Arterial Pressure


A-1141 Cooldown
Temp, C
Time, hours post-arrest
Gas Temperature
Burr hole
Pharyngeal

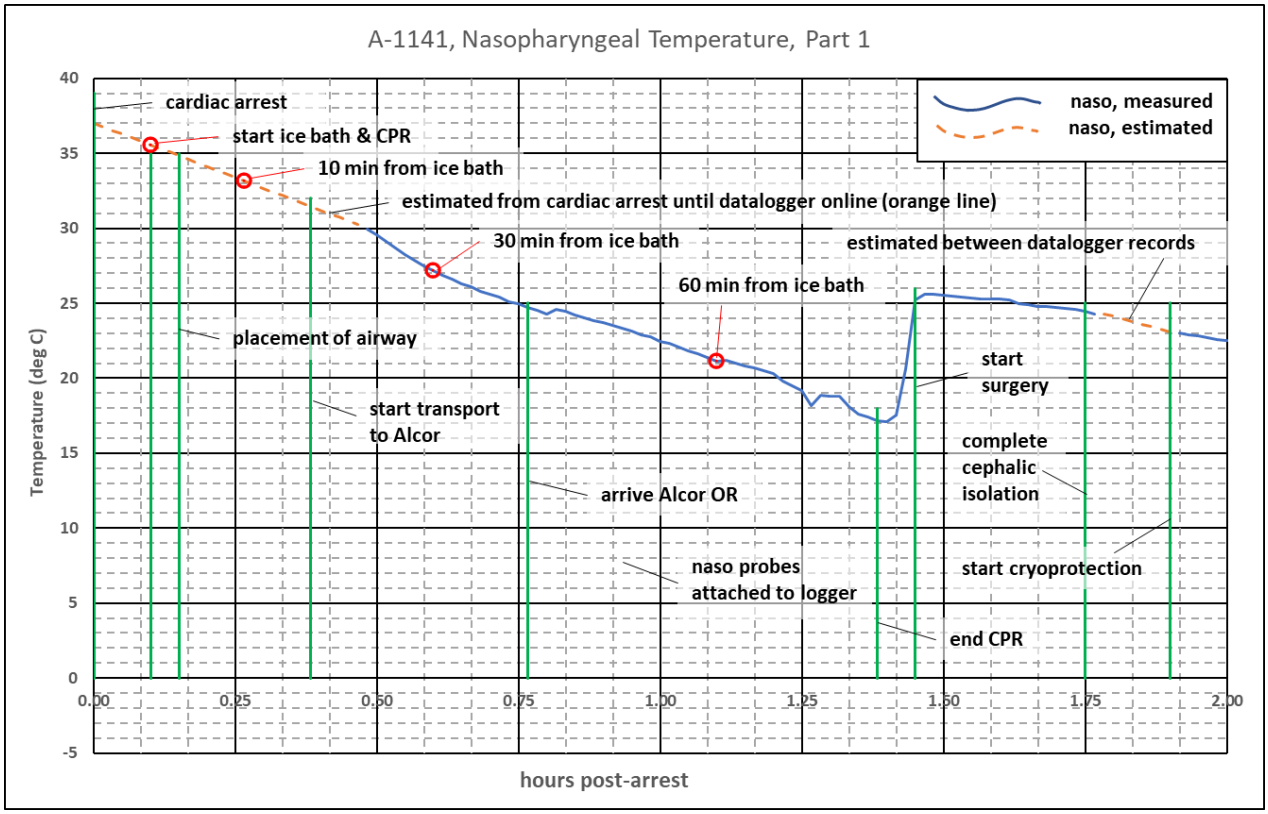

A-1141 Cooldown - Plunge
Gas Temperature
Burr hole
Pharyngeal
Temp, C
20
0
-20
-40
-60
-80
-100
-120
7
8
9
10
11
12
13
Time, hours post-arrest

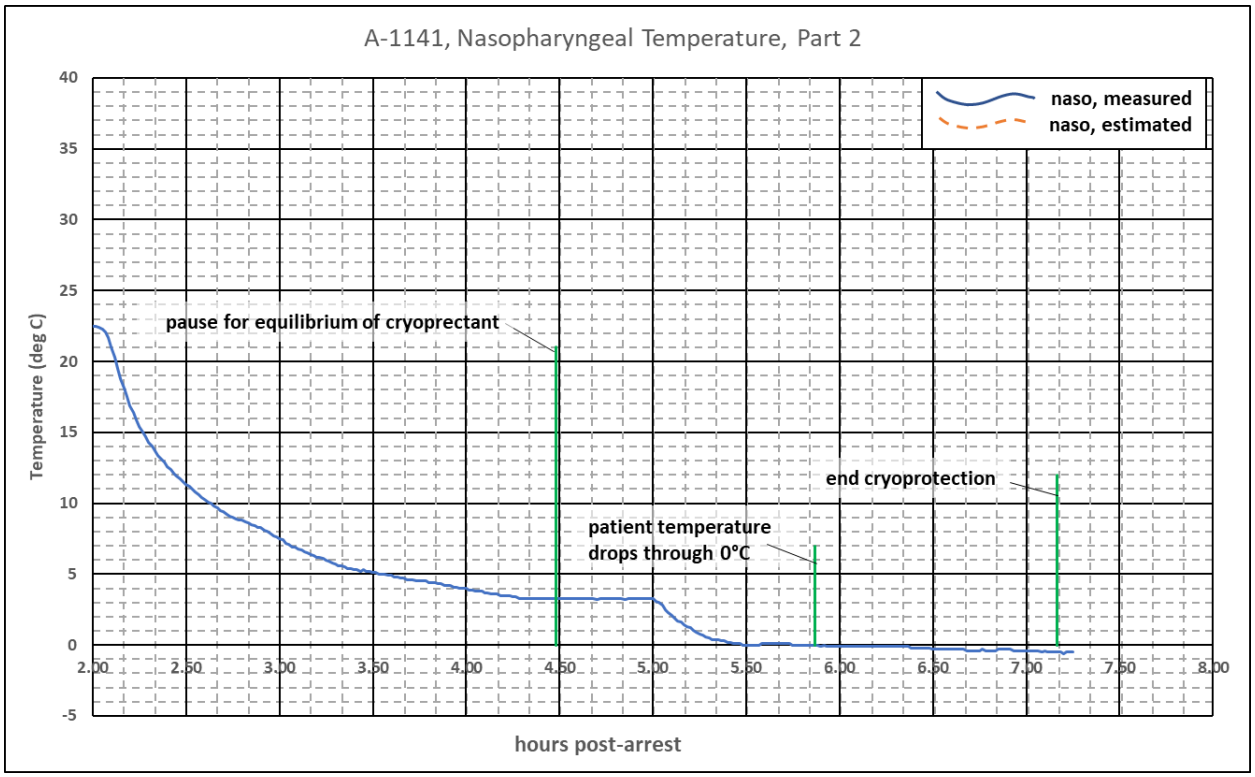
13. S-MIX

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 5:52. As shown below, and due to lowering of the body temperature, S-MIX duration is shorter, at 01:10.

event	segment #	days (T+X)	time (MST) duration	post-arrest	Tnaso (deg C)	CPS w/ ventil.	washout oxygen.	S-MIX (hh:mm)
Time of cardiac arrest		T-0	15:21	00:00	37.0			
	seg 1		00:06	00:06	-1.4	no	no	00:06
Start ice bath cooling & chest compressions		T-0	15:27	00:06	35.6			
	seg 2		00:03	00:03	-0.7	no	no	00:03
Placement of airway		T-0	15:30	00:09	34.8			
	seg 3		00:14	00:14	-3.4	yes	no	00:05
Start transport of patient to Alcor		T-0	15:44	00:23	31.5			
	seg 4		00:23	00:23	-6.7	yes	no	00:06
Arrival of patient in OR at Alcor		T-0	16:07	00:46	24.7			
	seg 5		00:37	00:37	-7.6	yes	no	00:06
Termination of cardiopulmonary support		T-0	16:44	01:23	17.2			
	seg 6		00:04	00:04	8.1	no	no	00:01
Start of surgery for cannulation and cephalic		T-0	16:48	01:27	25.3			
	seg 7		00:18	00:18	-0.8	no	no	00:08
Completion of cephalic isolation		T-0	17:06	01:45	24.5			
	seg 8		00:09	00:09	-1.4	no	no	00:04
Start of cryoprotectant ramp (FCP)		T-0	17:15	01:54	23.1			
	seg 9		02:35	02:35	-19.8	no	no	00:24
Pause for equilibrium at 50% of CNV achieved		T-0	19:50	04:29	3.3			
	seg 10		01:23	01:23	-3.3	no	no	00:07
Patient passes through 0C		T-0	21:13	05:52	0.0			
totals:			05:52	05:52	-37.0			01:10

The below plots show events related to the S-MIX calculation. 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.

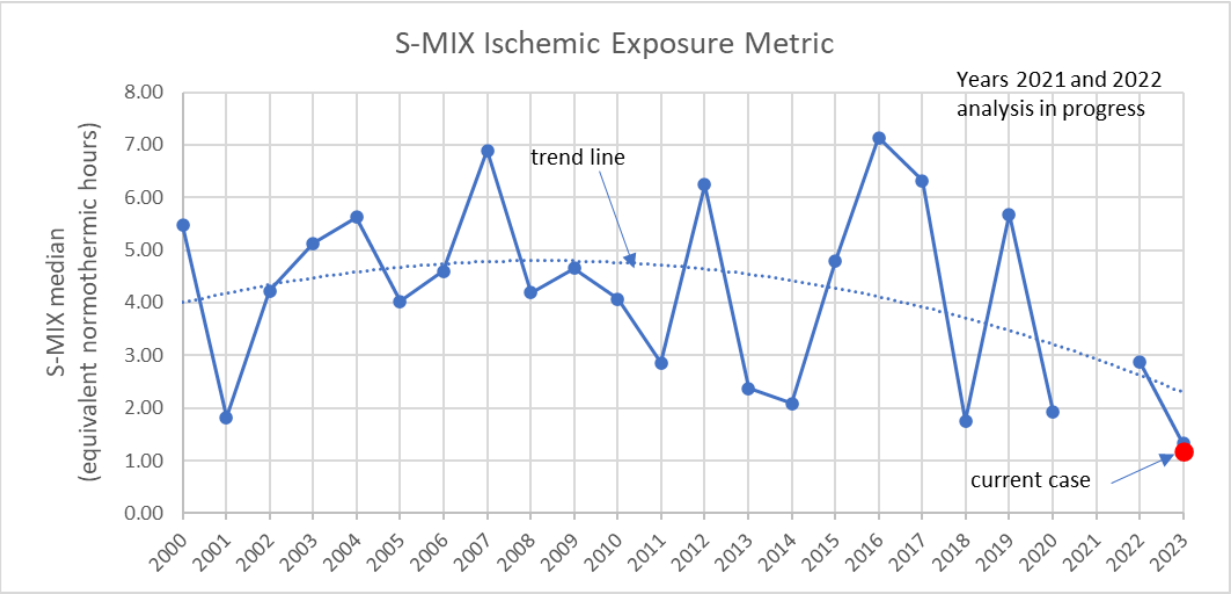

A-1141, Nasopharyngeal Temperature, Part 1
Temperature (deg C)
hours post-arrest
naso, measured
naso, estimated
cardiac arrest
start ice bath & CPR
10 min from ice bath
estimated from cardiac arrest until datalogger online (orange line)
30 min from ice bath
60 min from ice bath
estimated between datalogger records
placement of airway
start transport to Alcor
arrive Alcor OR
start surgery
complete cephalic isolation
naso probes attached to logger
start cryoprotection
end CPR


A-1141, Nasopharyngeal Temperature, Part 2
Temperature (deg C)
hours post-arrest
naso, measured
naso, estimated
pause for equilibrium of cryoprectant
end cryoprotection
patient temperature drops through 0°C

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

Patient Cooling Rate				(patient weight 85 kg; 187 lb)
ime = 0 at start of ice bath	0 min elapsed	10 min elapsed	30 min elapsed	60 min elapsed
Naso temperature (°C)	35.6	33.1	27.2	21.1
Temperature drop (°C) from t = 0	0.0	-2.4	-8.4	-14.4
Cooling rate (°C/min) from t = 0	N/A	-0.24	-0.28	-0.24

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



14. CT Scans

Cryoprotectant Distribution (Post-cryopreservation CT scan)

The post-cryogenic cooldown CT scan will be done with the patient at liquid nitrogen temperature (-196°C) when the in-house CT scanner is operational, Scans will be added to this report at that time.