Alcor A-1394

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-1394 was a 65-year-old member with whole-body cryopreservation arrangements. The death certificate stated the cause of death as metastatic cancer. Cardiac arrest was estimated to have taken place at 00:05 hrs on T-0 days and the member was pronounced legally deceased in California at 00:07 hrs on T-0 days in February of 2024.

After stabilization and field blood substitution, the patient was driven to Alcor for cryoprotectant perfusion and cryogenic cooldown. The patient arrived at Alcor on T+1 days at 15:32 hrs. The cryogenic cooldown was initiated on T+1 days at 20:38 hrs and terminated on T+5 days at 15:59 hrs. The patient was transferred to long-term care at liquid nitrogen temperature on T+11 days at 11:52 hrs.

2. Member Assessment

The member had been diagnosed with cancer years prior and had been admitted to a local hospital due to seizures a week prior to this deployment. The member was then discharged to home hospice with visits three times per week.

T-3 days

The member's family contacted Alcor at 11:26 hrs stating the member was unresponsive and the hospice nurse indicated that the member could possibly die within the next 48-hours. The family apologized for not calling sooner, but they had had difficulty finding the member's Alcor ID card and the member did not wear their bracelet or neck tag.

Before the Alcor Deployment and Recovery Team (DART) was deployed, Alcor's Medical Response Director (MRD) conducted a comprehensive member assessment to ascertain the immediate medical needs and status of the member. After preliminary evaluation of information gathered from the member's family and the hospice nurse, it was determined that the member was nonresponsive but presented with stable vital signs, indicating a critical yet controlled condition.

The member's initial vital signs were as follows: blood pressure (BP) 90/60 mmHg, heart rate (HR) 120 beats per minute, capillary oxygen saturation (SPO2) ranged from 84-90% on 8 liters per minute oxygen supply via a non-rebreather mask (NRB), respiratory rate (RR) 12 breaths per minute.

Intermittent daily monitoring was established to track any changes in the member's condition, with a focus on maintaining stability and comfort. Vital signs were documented at regular intervals to observe trends and identify any immediate medical interventions required. The monitoring efforts were to ensure that the Alcor team would be fully informed upon arrival and ready to initiate stabilization procedures without delay.

3. Deployment

Two members of the DART team, along with three members of the Suspended Animation (SA) team, an Alcor contractor for standby, stabilization, Transport (SST), and Field Blood Substitution services, were both activated at 11:38 hrs for a Level-1 deployment. The team, including a perfusionist, surgeon, and support staff, was mobilized promptly, with preparations for necessary medical interventions underway.

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 SA team loaded their SST equipment and 220 lbs. of water ice into their mobile operating vehicle (MOV) and deployed at 12:40 hrs. The SA team arrived at the member's home at 13:26 hrs and established contact with the family. At that time, the member was noncommunicative but was awake and able to track personnel in the room. The member's family attempted to communicate with the member and there was audible moaning as a response. The member was still producing urine, but in the past six days had only consumed 1.5 Ensure shakes and minimal water to moisten the mouth. The member's vital signs were: BP 110/47, HR 119, RR 18, SPO2 94% on 8L/min on NRB.

The Alcor DART team had left the Alcor facility in their mobile response vehicle (MRV) at 12:09 hrs and arrived at the member's location at 21:10 hrs. The SA contract surgeon arrived at a local airport at 23:10 hrs, and the contract perfusionist was due to arrive the following day at 12:00 hrs.

4. Standby

Upon DART's arrival at 12:09 hrs, the team promptly initiated standby procedures. This involved preparing the necessary medical and cryopreservation equipment, ensuring that all systems were operational and standing by for the imminent stabilization process. The team was in a state of readiness to commence stabilization protocols at a moment's notice.

The SA team stationed themselves at a local hotel 4 minutes away from the member's home and prepared their own equipment. At 14:45 hrs a hospice nurse was at the home to perform an evaluation for 24-hour care. During the visit, the member was alert to questions and attempting verbal communication. The nurse decided that 24-hour care was not yet needed. The member's vital signs were: BP 94/43, HR 120, RR 22 rhythmic non-labored, and SPO2 93% still on 8L/min with a non-rebreather mask (NRB).

A local funeral home was contacted and their availability for assistance in obtaining transit permits and issuing the death certifications was confirmed. Hospice personnel were contacted to ensure smooth processes and prompt pronouncement.

The hospice administration was put in contact with the local funeral director to pre-fill as much paperwork as possible, and the member's family filled out a personal information sheet to be

used for the death certificate. The funeral director was able to procure a direct number for a health department representative to assist in timely filing of the transit paperwork.

The family gave the member a 0.25ml dose of morphine at 06:00 hrs. The member was nonresponsive at 11:38 hrs. The member's vital signs were: BP 90/60, HR 120, SPO2 84-90% on 8L/min, RR 12. At 12:27 hrs the member was stable with no significant change in the vital signs.

The member's vital signs at 14:12 hrs were: BP 110/47, HR 119, SPO2 94%, RR 18. It was noted at 15:00 hrs that the member had opened the eyes and was tracking the nurse. The member's vital signs were: BP 94/43, HR 120, SPO2 93%, RR 22. The member had taken 10mL of water. There was no mottling on the hands or feet, and they were warm to the touch.

At 19:00 hrs the SA team received a parking permit to position their MOV in front of the member's home. All of the initial SST equipment was prepared, and the stabilization medications were placed in the hotel refrigerator, but not yet drawn up.

The family gave the member a 0.25 ml dose of morphine at 16:40 hrs. The member's vital signs at 21:45 hrs were: HR 116, BP 123/50, RR 20, SPO2 95% on 8L/min of oxygen with NRB. The hands and feet were warm, with no mottling. The member had taken another 7 mL of water. Both the SA team and Alcor's DART team made an evening visit to the member.

T-2 days

The member's vital signs at 09:46 hrs were: BP 132/67, RR 36, HR 129, SPO2 96% on 8L/min NRB. The MRD noted a change in the vital signs, and SA & DART confirmed the patient was showing increased signs of pain. At 04:00 hrs the member's family administered 0.2 ml morphine and 0.2 ml Lorazepam. The hospice nurse was scheduled to arrive later in the day to perform another evaluation for 24-hour care. At 11:00 hrs the family gave the member a 0.25 ml dose of lorazepam. At 13:10 hrs the family gave the member a 0.25ml dose of morphine.

The member's vital signs at 14:46 hrs were: temperature (T) 36°C, BP 137/81, HR 132, SPO2 97% on NRB. The hospice nurse requested that their physician increase the dose of morphine to 0.5 ml every 2 hours with as needed doses for breakthrough pain. At 19:56 hrs the hospice agreed to now provide 24/7 continuous care monitoring of the member. The hospice nurse indicated she felt the member may go into cardiac arrest that evening or early the next morning.

The SA team drew up the full set of stabilization medications at 20:00 hrs based on the member's weight at 104 kg. The medications were placed back in the hotel refrigerator.

T-1 days

At 07:50 hrs the SA team lead and one member of the DART team met with the attending nurse for the shift change. The night nurse had administered 1 ml of morphine and 0.5 ml of lorazepam every hour until 06:00 hrs. The member was now nonresponsive to verbal or tactile stimulation with very minimal urine output. The member's vitals were: BP 97/55, HR 124, RR 24, SPO2 90-95% on oxygen at 10 L/min via NRB, and T 36.8°C.

The member's vital signs at 08:00 hrs were: BP: BP 97/55, HR 124, RR 24, SPO2 90-95% on 10L/min NRB, T 37°C. The member had received hourly morphine of 1 ml and lorazepam of 0.5 ml until 05:00 hrs. The member was nonresponsive to verbal or tactile stimulation. The member had only minimal urine output, with no bowel movement.

The member's vital signs at 12:00 hrs were: BP 109/59, HR 118, RR 24, SPO2 97 on 10L/min of oxygen via NRB, with audible gurgling during respiration. No mottling was seen, the hands and feet were warm. The member was still non-responsive.

At 18:03 hrs slight respiratory changes were observed with more pronounced gurgling with respirations. The member's vital signs were: BP 92/53, HR 120, RR 28, SPO2 97%.

The member's vital signs at 19:10 hrs were: HR 116, BP 123/50, RR 20, SPO2 95%. The Alcor team received a text from a hospice nurse at 21:00 hrs that the member's SPO2 had been dropping, was then around 78%, and breathing had become more rapid. The SA/DART team prepared to be positioned outside the home. At 21:30 hrs the nurse texted again that the member was exhibiting Cheyne-Stokes breathing. The SA/DART team was onsite at 21:45 hrs. The member had friends visiting, so the team remained positioned outside the home.

The initial stabilization equipment with the portable ice bath (PIB) was moved to the side of the front door in the driveway, allowing the family a respectful distance while still being close enough for rapid stabilization. The PIB had ~200lbs. of water ice and 2 gal of water for the initial cooling. At 22:30 hrs the family agreed to lower the oxygen and titration started at 8L/min on NRB. At 23:00 hrs the member's vitals were BP 85/46, HR 133, RR 44, SpO2 72% at 8L/min, T 37°C.

T-0 days

The member went into cardiac arrest at 00:05 hrs and was declared legally deceased at 00:07 hrs. The family members and friends quickly departed the member's bedside, and the SA/ DART team moved into the home and began recovery and stabilization procedures.

5. Patient Recovery and Stabilization

At 00:09 hrs the team comprised of two SA members and two DART members was at the bedside with the portable ice bath (PIB). Because there were four members to assist with the stabilization many tasks were performed simultaneously.

The patient was transferred to the PIB at 00:11 hrs. Mechanical chest compressions were started with the Autopulse at 00:12 hrs. Approximately 200 lbs. of water ice was added to the patient's head and body. The recirculating water mask was positioned on the patient's head but would not be initiated until out of the patient's home.

The Combitube airway was placed at 00:13 hrs. The SAVe AutoMedx ventilator was connected to the airway with an impedance threshold device and CIM-800 capnograph. Upon starting the ventilator, the capnograph was not reading. Stabilization had to proceed without a functioning capnograph (see the Discussion section). The member was then draped with a privacy sheet and transported to the MOV.

Once inside the MOV, the surface convection cooling device (SCCD) pump was initiated at 00:17 hrs. Adequate flow was observed through the mask and tubing. Temperature probes were placed in the left and right nasopharynx and secured with nasal putty at 00:18 hrs. An additional 2 gallons of water was added to the ice bath to ensure flow in the SCCD mask.

An EZ-IO device was placed in the right tuberosity at 00:19 hrs. The administration of stabilization medications was started at 00:20 hrs (see the below Table of Medications Administered for the names of the medications, the dosages, and the times of administration). The syringe containing propofol broke off inside the IO tubing at 00:20 hrs, resulting in the removal of the tubing and the drug was administered directly into the IO port. A second tubing was attached and used for the remainder of the medications (see the Discussion section).

An 8x10" Tegaderm patch was used to seal the mouth. The Autopulse suddenly stopped at 00:21 hrs but was restarted after 25 seconds. Another ~180 lbs. of water ice was added to the PIB. The medication administration continued and transport of the patient to the surgical site began at 00:27 hrs.

During transport, the perfusionist and SA team lead remained in the back of the MOV to continue medication administration and to prepare the area for surgery. The SCPC perfusion pump would also supply 5L/min room air into the circuit. Both 250,000 IU streptokinase and the leftover 57 ml full concentration Vital-Oxy were drawn up to be added to the circuit during blood substitution.

6. Field Blood Substitution

At 01:09 hrs the patient arrived at the surgical location (the SA California headquarters) and the MOV was quickly pulled inside the garage. The surgeon scrubbed in as the SA/DART team prepared for surgery and monitored the patient's temperature. At 01:17 hrs the Alcor MRD was contacted about slow external cooling rates due to the large size of the patient. The MRD agreed with the SA team lead that cannulation and perfusion with cold solution without waiting for the patient to reach 20°C would hasten cooling and minimize ischemic damage.

At 01:23 hrs chest compressions were stopped to initiate surgery. Both the left and right NPT were 31°C. The first surgical cut was made at 01:25 hrs. The adipose tissue made it difficult to locate the sternal notch. The medial line on the chest was located and the Stryker sternal saw was used to gain access to the chest cavity at 01:34 hrs. The ascending aorta for arterial cannulation, and inferior vena cava for venous perfusion, were identified. It was also noted that the patient had slightly abnormal chest anatomy.

The initial opening was made off midline, but the surgeon proceeded to canulate. Canulation would be more difficult with the initial opening off center (see the Discussion section). The aorta was cannulated with a 21 French (Fr) Edwards curved tip cannula at 01:45. The inferior vena cava was cannulated with a 29/37 dual stage Edwards cannula at 01:49 hrs. The cannulae required reducers to be compatible with the perfusion circuit.

Open bypass began at 01:55 hrs with MHP2 organ transport solution, and 250,000 IU Streptokinase administered immediately. The arterial pressure never exceeded 100 mmHg. The initial flow rate was 2L/min.

Closed circuit perfusion started at 02:09 hrs and perfusate bag with 11 L was added to the perfusion circuit. Recirculation was terminated at 02:55 hrs with a delivery temperature of 0.3°C and return temperature of 2.5°C.

The SA/DART team began bagging approximately 200 lbs. of water ice in double Ziploc bags for transportation of the member. The bagged ice was placed in a cooler to prevent melting and stored to await packing around the member.

After termination of recirculation, it was discovered that the venous cannula needed additional suturing to create a better seal. At 03:00 hrs an additional suture was placed and a better seal around the venous canula was made.

The cannulae were looped together with a length of tubing at 03:06 hrs and the surgeon began closing the patient. Due to the cut being off midline, closing proved more difficult than usual. The closure was complete at 03:45 hrs.

7. Patient Transport to Alcor

At 04:01 hrs the SA/DART team began the process of transferring the member from the SA mobile operating vehicle (MOV) to the DART gurney. Straps were guided under the member and used to assist in the lifting and transferring. Once the member was on the DART gurney and placed inside a heavy-duty body bag, 200 lbs. of double-bagged ice was added around the member. The remaining HOBO data logger was placed in a Ziploc bag and transported with the patient.

The patient was loaded into the Alcor mobile recovery vehicle (MRV) at 04:04 hrs and the DART team began patient transport to the California border to await the transit permit at 04:14 hrs.

At 09:39 hrs the funeral director was waiting on hospice to confirm the causes of death to submit to the health department at 10:00 hrs when they were to open. At 09:52 hrs the funeral director received the causes from the hospice and had a direct number to a health department representative. The attending physician spoke with the funeral home and stated he would perform the attestation as soon as the permit office submitted the death certificate into the electronic death registration system.

At 10:00 hrs the funeral director made numerous calls to the Health Department. At 10:45 hrs SA also began calling the Health Department. The funeral director finally reached the Health Department, and the transit permit was issued at 12:08 hrs. Alcor's DART team was sent the permit, and they began transit to Alcor's facility. Upon arriving at 15:32 hrs, the care of the patient was transferred to the waiting Alcor staff.

8. Cryoprotectant Perfusion Surgery at Alcor

10 liters B1 perfusate had been put into mixing reservoir. Perfusion would start with a cryoprotectant concentration of 13.0 Brix for OR washout because it had been over 17 hours between the time of cardiac arrest (resulting in cold ischemia). Streptokinase had been administered during the field washout.

The patient arrived at the back door to Alcor at 15:29 hrs and was moved into the operating room (OR) at 15:32 hrs. Insulation and packaging were removed from around the patient. At 15:34 hrs the initial nasopharyngeal temperature (NPT) from data logger (RNPT = 0.8 °C).

There was no Megamover under the patient. One was laid down on the OR table at 15:39 hrs, before the patient was placed on the table, to be used for transfer into the cooldown box. Ice bags were placed back around the patient at 15:40 hrs. Thermistors were placed in both nares at 15:45 hrs and connected to the data acquisition system on the computer. The initial NPT reading was 0.8°C.

The cannulae were still in place from the field blood substitution. The venous cannula was connected to the circuit tubing and secured with zip ties at 15:56 hrs. The arterial cannula was connected to the circuit tubing and secured with zip ties at 15:57 hrs.

9. Cryoprotectant Perfusion at Alcor

The open-circuit perfusion was initiated at 16:00 hrs with a cryoprotectant concentration of 13.0 Brix, but there was no return flow. At 16:01 hrs the tubing was adjusted and return flow started. The venous effluent was nearly clear.

The cryoprotectant ramp was started at 16:03 hrs. The circuit was placed on computer control with a target arterial pressure of 80 mmHg. There was minimal leakage to the table.

At 16:25 hrs the arterial pressure was turned down to 70 mmHg to correct an erratic graph on the OR monitor. At 16:37 hrs the arterial pressure was further lowered to 60 mmHg. The pressure had stabilized at 16:41 hrs and the arterial pressure was increased to 70 mmHg.

Nitrogen gas was turned on to flow over the patient to improve external cooling. The table and the patient were covered with plastic wrap at 17:10 hrs to conserve the nitrogen gas and lower the patient’s temperature below 0°C.

The refractive index (RI) of the effluent from the venous sampling port at 17:27 hrs was 31.18 Brix, or about half the concentration needed to vitrify (CNV). The 30-minute pause for equilibrium was started at 17:27 hrs and the target temperature of the patient enclosure was switched from 3°C to -3°C.

Sidebar:
Per the cryoprotection protocol, the ramp is to be paused at 30 Brix (approximately 50% of the desired terminal concentration of 52.5 Brix) to allow the patient to come to osmotic equilibrium. 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 (49.9

Brix x 105% = 52.5 Brix) and held between 102% and 105% concentration until the terminal concentration is obtained.

The equilibration pause was terminated at 17:57 hrs and the main pump turned to full speed for the remainder of the cryoprotectant perfusion ramp.

General tanning of the patient's skin was noted at 18:23 hrs, except for the left side of the chest, at the suture line (almost exactly). The eyes could not be checked as there was a bag of crushed ice over the patient's face being used as a spacer to hold the plastic wrap from touching the patient, thereby increasing the flow of nitrogen gas around the patient.

The pump speed was decreased slightly at 18:45 hrs to bring the arterial RI down to meet the venous RI. The pump appeared to enter a feedback loop 19:34 hrs and was switched temporarily to manual control. The pump was placed back on computer control 19:38 hrs.

Sidebar:
Per the cryoprotection protocol, a 30-minute countdown to the termination of cryoprotection is initiated, after which the final sub-zero terminal concentration ramp is resumed. The normal endpoint criterion for whole body patients is over 100% for over 30 minutes from the venous return and for neuro patients, it is over 100% target cryoprotectant concentration for over 30 minutes from both jugular veins. The speed of the addition pump is minimized, with frequent corrections, to compensate for latency.

The venous RI reached 51.36 Brix at 19:49 hrs. The 30-minute countdown to termination of cryoprotectant perfusion was started. At 20:20 hrs the cryoprotectant perfusion ramp was terminated. The final RI reading showed an effluent concentration of 52.65 Brix.

The process to remove lines and equipment from the patient and to close the cannulation site started at 20:21 hrs. At 20:25 hrs the left eye had collapsed, the right eye had not. The patient was moved to the Patient Care Bay for cooldown at 20:28 hrs. The cryogenic cooldown was started at 20:38 hrs.

10. Cooling to Liquid Nitrogen Temperature

Computer-controlled cryogenic cooldown was initiated at 20:38 hrs on T+0 days, plunging to -110°C and descending thereafter at -1°C/hour to liquid nitrogen temperature. During the transfer from the horizontal box to the vertical dewar, the team discovered that the burr hole probe had become dislodged and was exposed to air. The probe could not be replaced and was not connected to the cooldown system after the transfer.

On T+5 day at 15:59 hrs, an uneventful cooldown was terminated. On T+11 days at 11:52 hrs, the patient was transferred to long-term care at liquid nitrogen temperature.

11. Timeline and Time Summaries

Timeline

T-0	00:05	Estimated time of cardiac arrest
T-0	00:07	Time of legal pronouncement
T-0	00:11	Start of ice bath cooling
T-0	00:12	Start of chest compressions
T-0	00:13	Placement of airway
T-0	00:19	Placement of IO
T-0	00:20	Administration of first medication (propofol)
T-0	00:27	Start transport of patient to location of surgery/washout
T-0	00:38	Administration of final medication (Hetastarch)
T-0	01:09	Arrive at location of surgery and washout
T-0	01:23	Termination of cardiopulmonary support (both NPTs 31°C)
T-0	01:25	Start of field surgery (median sternotomy, cannulation)
T-0	01:49	Completion of field surgery
T-0	01:55	Start of open-circuit washout
T-0	02:09	Start of closed-circuit perfusion
T-0	02:55	Completion of closed-circuit perfusion
T-0	04:14	Departure of transport vehicle to Alcor
T-0	15:32	Arrival of patient at Alcor OR (RNTP = 0.8°C)
T-0	15:46	Burr hole thermistor placed - end of surgery
T-0	15:56	Connection of cannulae to tubing circuit
T-0	16:03	Start of cryoprotectant ramp
T-0	17:27	Pause at 50% of CNV achieved
T-0	17:57	Off pause with sub-zero terminal concentration ramp
T-0	19:49	Start 30-minute countdown to end of ramp
T-0	20:20	Termination of cryoprotection (final RI = 52.65 BRIX)
T-0	20:38	Start of cryogenic cooldown
T+5	15:59	Completion of cryogenic cooldown
T+11	11:52	Transfer of patient to long-term care at LN2

Time Summaries

Event Duration hr:min		days	time	
00:02	From:	T-0	00:05	Estimated time of cardiac arrest
	Till:	T-0	00:07	Time of legal pronouncement
00:06	From:	T-0	00:05	Estimated time of cardiac arrest
	Till:	T-0	00:11	Start of ice bath cooling
00:07	From:	T-0	00:05	Estimated time of cardiac arrest
	Till:	T-0	00:12	Start of chest compressions
00:15	From:	T-0	00:05	Estimated time of cardiac arrest
	Till:	T-0	00:20	Administration of first medication (propofol)
00:18	From:	T-0	00:20	Administration of first medication (propofol)
	Till:	T-0	00:38	Administration of final medication (Hetastarch)
01:20	From:	T-0	00:05	Estimated time of cardiac arrest
	Till:	T-0	01:25	Start of field surgery (median sternotomy, cannulation)
14:21	From:	T-0	01:25	Start of field surgery (median sternotomy, cannulation)
	Till:	T-0	15:46	Burr hole thermistor placed - end of surgery
01:50	From:	T-0	00:05	Estimated time of cardiac arrest
	Till:	T-0	01:55	Start of open circuit washout
01:00	From:	T-0	01:55	Start of open circuit washout
	Till:	T-0	02:55	Completion of closed circuit perfusion
02:50	From:	T-0	00:05	Estimated time of cardiac arrest
	Till:	T-0	02:55	Completion of closed-circuit perfusion
15:27	From:	T-0	00:05	Estimated time of cardiac arrest
	Till:	T-0	15:32	Arrival of patient at Alcor OR (RNTP = 0.8°C)
00:24	From:	T-0	15:32	Arrival of patient at Alcor OR (RNTP = 0.8°C)
	Till:	T-0	15:56	Connection of cannulae to tubing circuit
15:58	From:	T-0	00:05	Estimated time of cardiac arrest
	Till:	T-0	16:03	Start of cryoprotectant ramp
00:31	From:	T-0	15:32	Arrival of patient at Alcor OR (RNTP = 0.8°C)
	Till:	T-0	16:03	Start of cryoprotectant ramp
00:07	From:	T-0	15:56	Connection of cannulae to tubing circuit
	Till:	T-0	16:03	Start of cryoprotectant ramp
04:17	From:	T-0	16:03	Start of cryoprotectant ramp
	Till:	T-0	20:20	Termination of cryoprotection (final RI = 52.65 BRIX)
04:17	From:	T-0	16:03	Start of cryoprotectant ramp
	Till:	T-0	20:20	Termination of cryoprotection (final RI = 52.65 BRIX)
00:18	From:	T-0	20:20	Termination of cryoprotection (final RI = 52.65 BRIX)
	Till:	T-0	20:38	Start of cryogenic cooldown
20:33	From:	T-0	00:05	Estimated time of cardiac arrest
	Till:	T-0	20:38	Start of cryogenic cooldown
05:06	From:	T-0	15:32	Arrival of patient at Alcor OR (RNTP = 0.8°C)
	Till:	T-0	20:38	Start of cryogenic cooldown

12. Table of Medications Administered

T-0 days

TIME	MEDICATION	DOSE	PURPOSE
00:20 hrs	Propofol	200 mg	Anesthetic; reduces cerebral metabolic demand; reduces the theoretic possibility of increased awareness during aggressive CPS.
00:22 hrs	Sodium citrate	10 g Note 1	Anticoagulant; prevents blood clot formation.
00:23 hrs	Heparin	50,000 IU	Anticoagulant; prevents blood clot formation.
00:23 hrs	Vasopressin (1st dose)	40 IU Note 2	Vasopressor; increases blood pressure during CPS.
00:24 hrs	Minocycline	200 mg	Antibiotic and neuroprotectant
00:24 hrs	SMT (S-methyl-isothiourea)	400 mg Note 3	Neuroprotectant (iNOS inhibitor); protects the brain from ischemic injury; raises blood pressure.
00:26 hrs	Decaglycerol/THAM	200 ml Note 4	Decaglycerol inhibits cerebral edema.
00:26 hrs	Vasopressin (2nd dose)	40 IU Note 2	Vasopressor; increases blood pressure during CPS.
00:27 hrs	Vital Oxy (w/ saline)	40 mL Note 5	Antioxidants: melatonin, vitamin E (D-alpha tocopherol), PBN (alpha Phenyl t-Butyl Nitrone) and anti-inflammatory carprofen.
00:30 hrs	Decaglycerol/THAM	200 ml Note 4	Decaglycerol inhibits cerebral edema.
00:31hrs	Antacid	250 ml Note 6	A buffer used to neutralize stomach acid.
00:38 hrs	Hetastarch	300 ml Note 7	Restore volume in dehydrated patients and increase cerebral perfusion during CPS.
01:56 hrs	Streptokinase	250,000 IU Note 8	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 and therefore received 10 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 400 ml to be given in two separate doses.

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. Hetastarch is a volume expander used to restore volume in dehydrated patients and increase cerebral perfusion during CPS. It is administered 250 mL as a fixed dosage by I.V.

8. 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.

13. Discussion

Standby and Stabilization

Suspended Animation (SA) and Alcor's Deployment and Recovery Team (DART) were both deployed on this case. Both teams attended each visit with the member and effectively coordinated their roles, giving added value to the case.

The CIM-800 Capnograph, which is part of the SA equipment, did not record data from the endotracheal tube. The moisture filter was struck on the door frame while entering the home. This broke the tubing connector for the capnograph. Going forward the tubing will not be connected to the recording unit until the moment of connection at the endotracheal tube.

The needle of the syringe with the first medication, propofol, snapped off in the tubing line to the EZ-IO. This made the tubing unusable to administer medications. The second EZ-IO needle package was opened, and the tubing was used from that package to reestablish a functional EZ-IO port.

The member had an abundance of adipose tissue that made it difficult to cool externally, as well as internally. An additional 11 liters of perfusate were used to extend the cooling time and achieve a better ending temperature. An extra 11 liters of perfusate was available for this patient due to the local proximity to the SA California office. Extra perfusate may be an ongoing consideration for larger patients in the future.

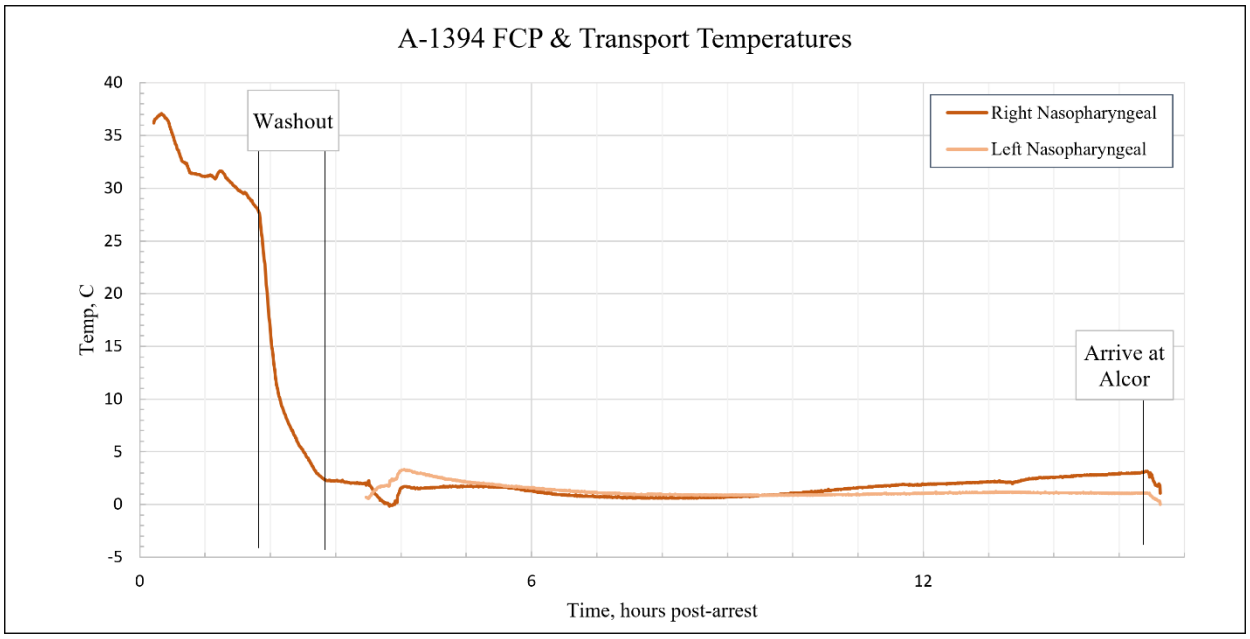
Field Surgery and Washout

The sternal notch was difficult to identify on the patient's chest. This resulted in sternal access that was off the midline making cannulation even more difficult. In the event the surgeon cannot

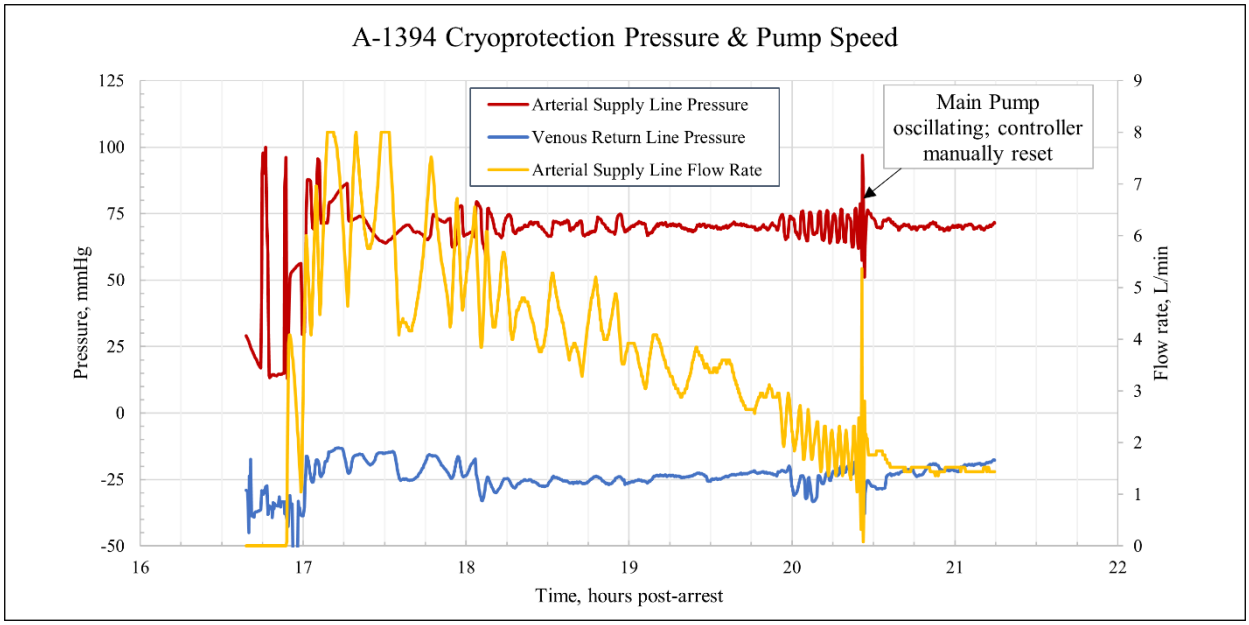
identify the median sternotomy landmarks, a surgical assistant, and perfusionist will be consulted to provide their opinion. The surgeon will ultimately have the final decision.

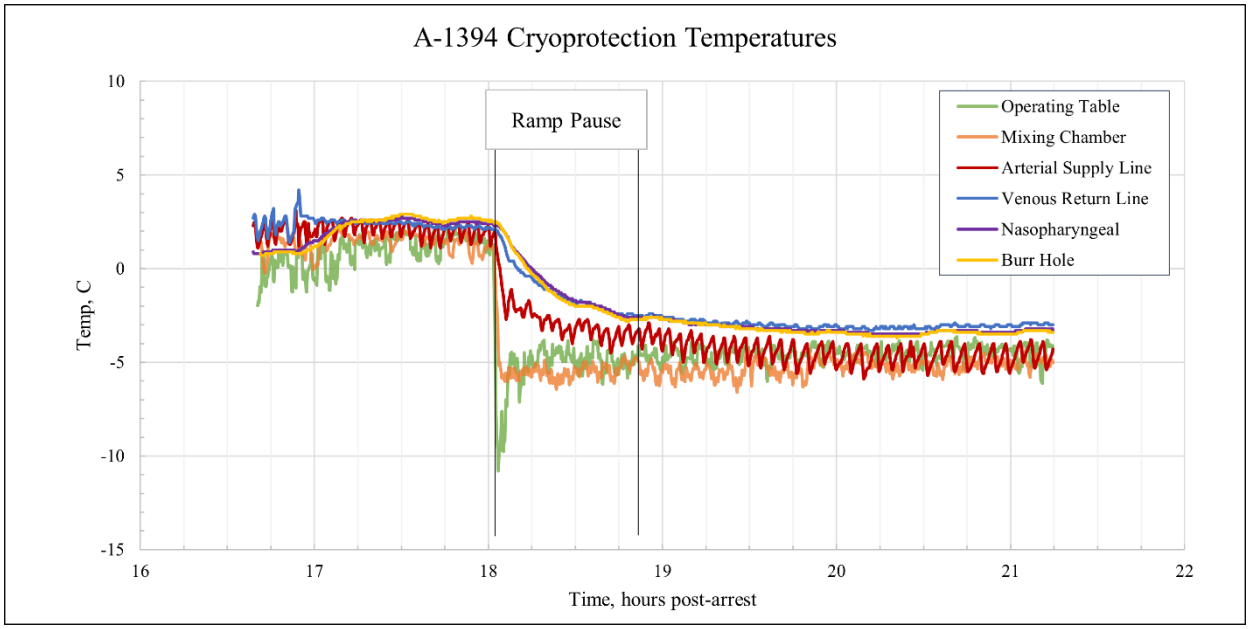
The venous cannula used for bypass required a ½" tubing connection. The SA perfusion circuit uses 3/8" tubing and needed adapters to be compatible. The cannula will be examined prior to the initial stabilization and the appropriate connectors will be assembled and available during the cannulation procedure.

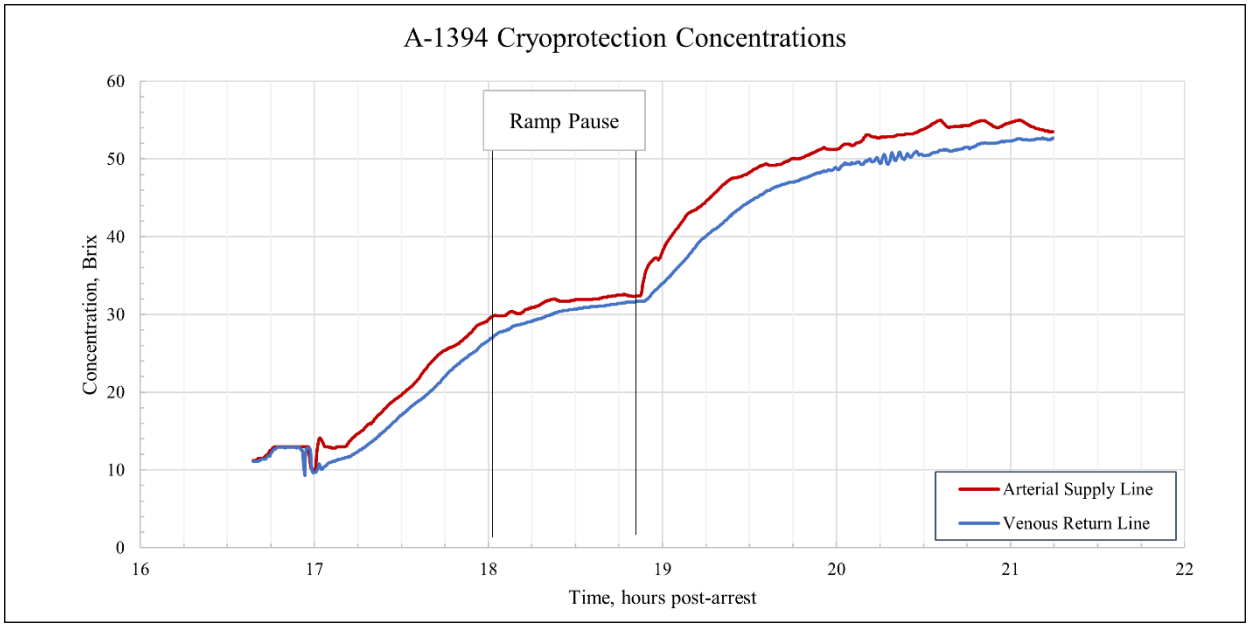
14. Cryoprotection and Temperature Graphs

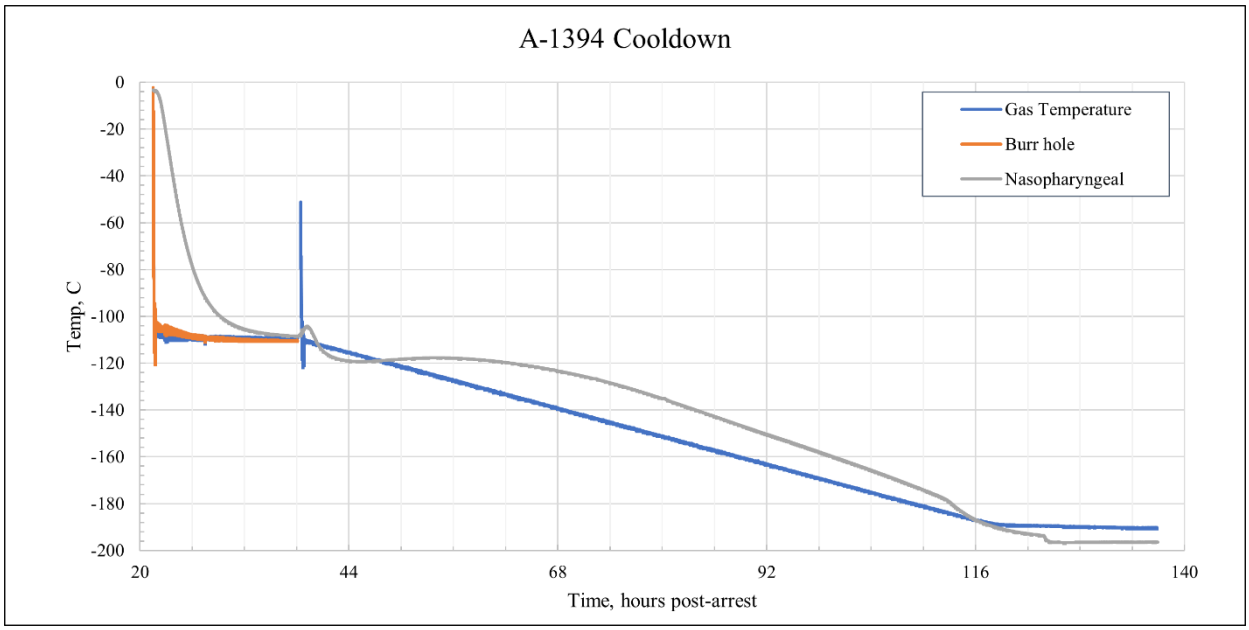


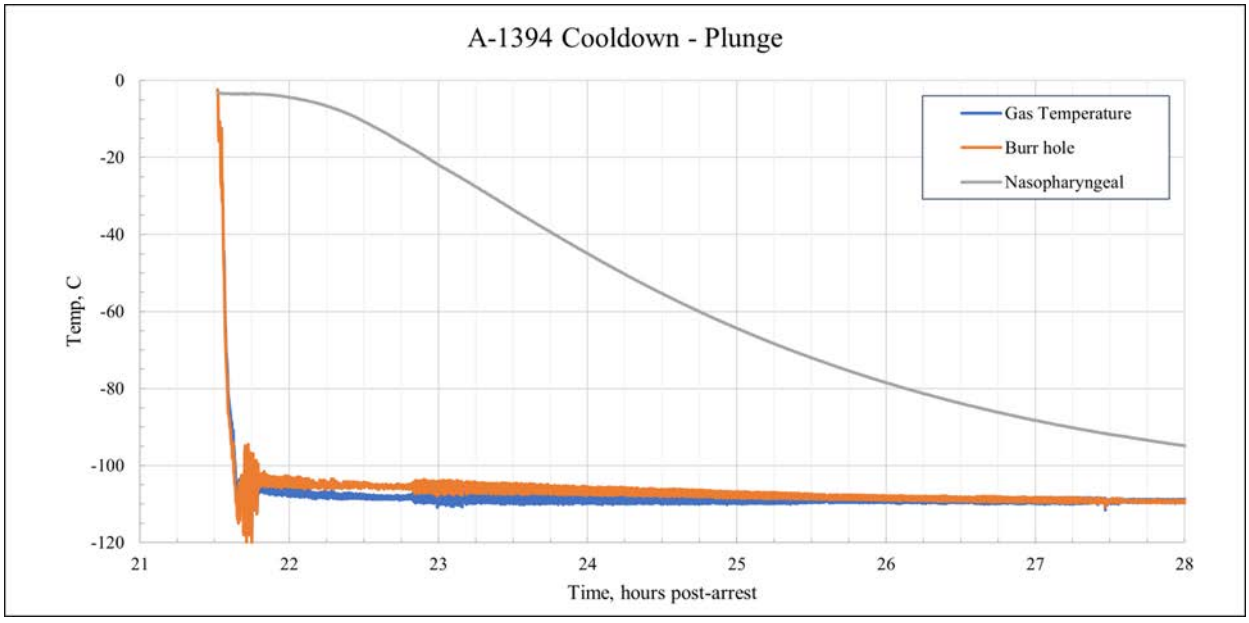
Transportation of the patient was largely uneventful. For an unknown reason, the left nasopharyngeal probe recorded noise until approximately 3.5 hours post-arrest, at which point it began to function properly. No other notable events occurred during transport.


A-1394 Cryoprotection Pressure & Pump Speed
Arterial Supply Line Pressure
Venous Return Line Pressure
Arterial Supply Line Flow Rate
Main Pump oscillating; controller manually reset
Pressure, mmHg
Flow rate, L/min
Time, hours post-arrest
125
100
75
50
25
0
-25
-50
9
8
7
6
5
4
3
2
1
0
16
17
18
19
20
21
22


A-1394 Cryoprotection Temperatures
Ramp Pause
Operating Table
Mixing Chamber
Arterial Supply Line
Venous Return Line
Nasopharyngeal
Burr Hole
Temp, C
Time, hours post-arrest
10
5
0
-5
-10
-15
16
17
18
19
20
21
22


A-1394 Cryoprotection Concentrations
Ramp Pause
Concentration, Brix
Time, hours post-arrest
Arterial Supply Line
Venous Return Line
0
10
20
30
40
50
60
16
17
18
19
20
21
22


A-1394 Cooldown
Temp, C
Time, hours post-arrest
Gas Temperature
Burr hole
Nasopharyngeal
0
-20
-40
-60
-80
-100
-120
-140
-160
-180
-200
20
44
68
92
116
140

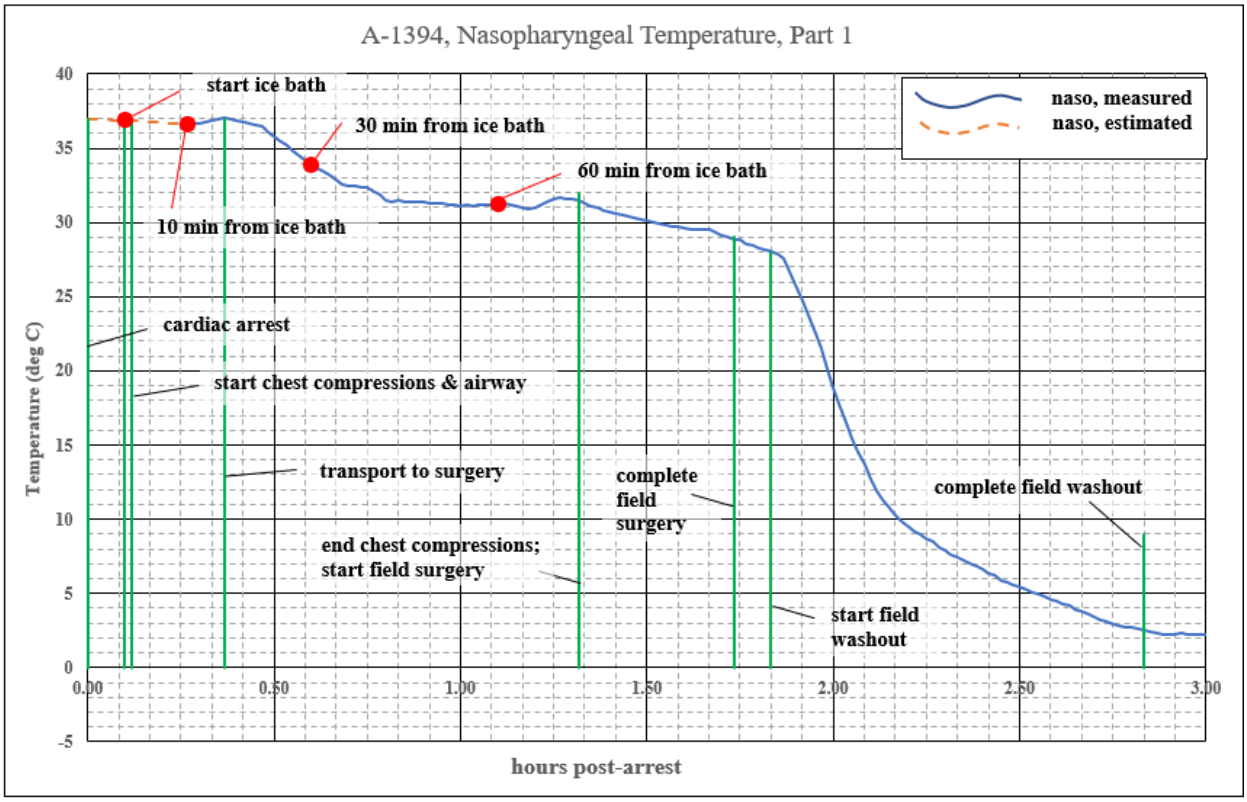

A-1394 Cooldown - Plunge
Gas Temperature
Burr hole
Nasopharyngeal
Temp, C
0
-20
-40
-60
-80
-100
-120
21
22
23
24
25
26
27
28
Time, hours post-arrest

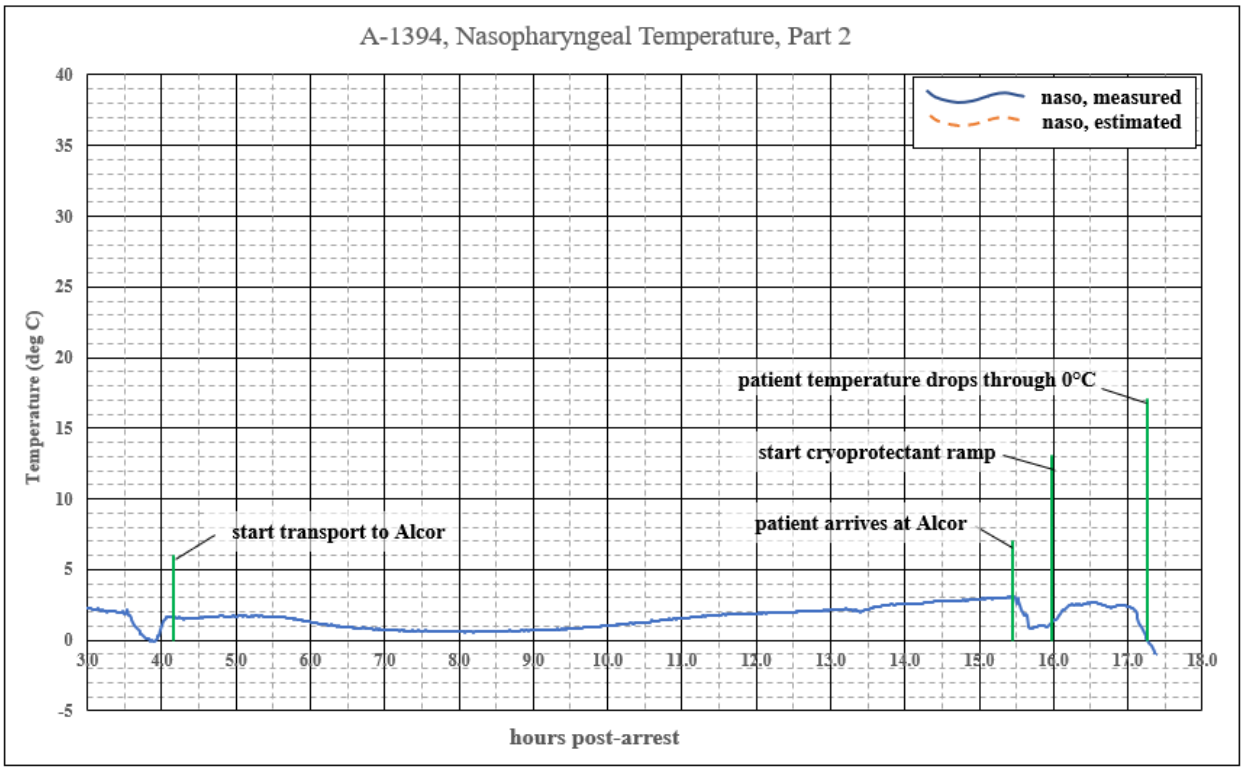
15. S-MIX

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 17:16. As shown below, and due to lowering of the body temperature, S-MIX duration is shorter, at 02:09.

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	00:05	00:00	37.0			
	seg 1		00:06	00:06	-0.1	no	no	00:06
Start of ice bath cooling		T-0	00:11	00:06	36.9			
	seg 2		00:01	00:01	0.0	no	no	00:01
Start of chest compressions & airway		T-0	00:12	00:07	36.8			
	seg 3		00:15	00:15	0.2	yes	no	00:07
Start transport of patient to surgery location		T-0	00:27	00:22	37.1			
	seg 4		00:57	00:57	-5.6	yes	no	00:21
End cardio support, start field surgery		T-0	01:24	01:19	31.4			
	seg 5		00:25	00:25	-2.6	no	no	00:15
Completion of field surgery		T-0	01:49	01:44	28.9			
	seg 6		00:06	00:06	-0.8	no	no	00:03
Start washout with oxygenation		T-0	01:55	01:50	28.1			
	seg 7		01:00	01:00	-25.5	no	yes	00:00
Complete field perfusion with MHP2 solution		T-0	02:55	02:50	2.5			
	seg 8		01:19	01:19	-0.9	no	no	00:07
Departure of transport vehicle to Alcor		T-0	04:14	04:09	1.7			
	seg 9		11:18	11:18	1.4	no	no	00:58
Arrival of patient at Alcor OR		T-0	15:32	15:27	3.1			
	seg 10		00:31	00:31	-1.9	no	no	00:03
Start of cryoprotectant ramp		T-0	16:03	15:58	1.2			
	seg 11		01:18	01:18	-1.2	no	no	00:07
Patient temperature passes thru 0°C		T-0	17:21	17:16	0.0			
totals:			17:16	17:16	-37.0			02:09

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.

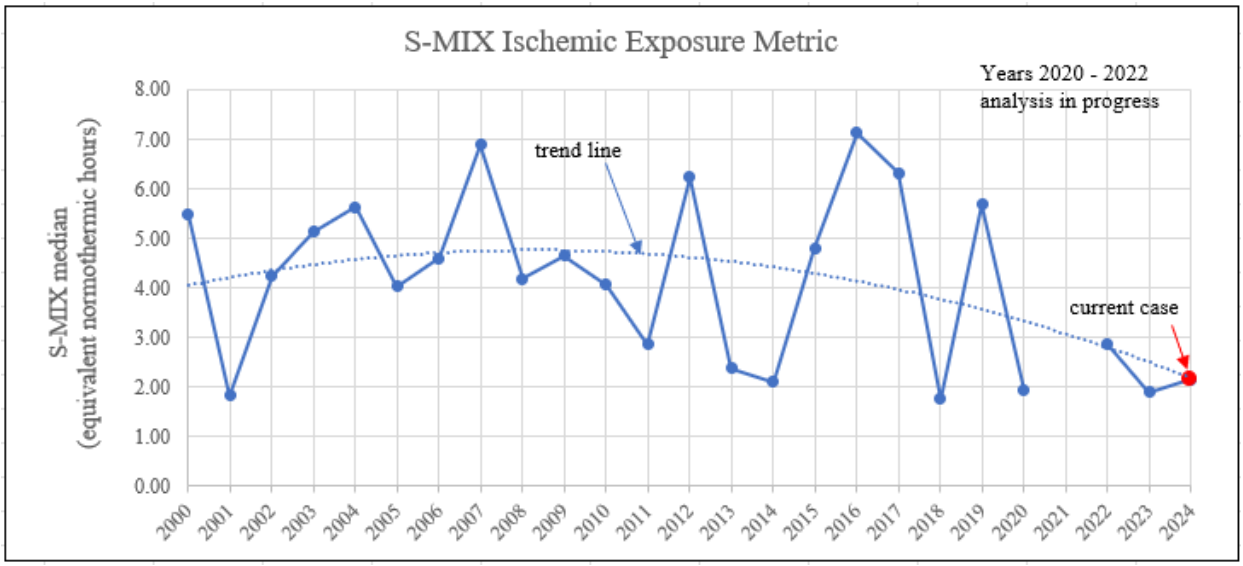




The below table provides cooling data for 10, 30, and 60 minutes after the team first applies water ice.

Patient Cooling Rate				(patient weight 110 kg; 243 lb)
Note: time = 0 at start of ice bath	0 min elapsed	10 min elapsed	30 min elapsed	60 min elapsed
Naso temperature (°C)	36.9	36.7	33.9	31.2
Temperature drop (°C) from t = 0	0.0	-0.2	-3.0	-5.6
Cooling rate (°C/min) from t = 0	N/A	-0.02	-0.10	-0.09

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



16. CT Scans

Cryoprotectant Distribution (Post-cryopreservation CT scan)

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