Alcor A-1132
Case Report

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1. Summary

Information was derived from multiple sources and was all converted to Mountain Standard Time (HRS). For de-identification, dates are not shown. T-0 represents the date of pronouncement of legal death, T-X represents occurrences before T-0, and T+X represents occurrences following T-0.

A-1132 was an 85-year-old member with whole body cryopreservation arrangements. The member had been admitted to a hospital for possible sepsis resulting from a urinary tract infection. The causes of death per the death certificate were acute cholangitis (bile duct damage), acute blood loss anemia, gastrointestinal bleeding, gastrointestinal arteriovenous malformation, acute renal failure, metabolic encephalopathy, and acute hypoxic respiratory failure. The member went into cardiac arrest at approximately 17:53 hrs and was pronounced legally deceased in California at 17:54 hrs on T-0 days in July of 2022.

After stabilization and remote blood substitution with MHP-2, the patient was driven to Alcor for cryoprotectant perfusion. The patient arrived in the operating room at Alcor on T+1 days at 11:37 hrs. The cryogenic cooldown was initiated on T+1 days at 17:08 hrs and was terminated on T+6 days at 11:16 hrs. The patient was transferred to long-term maintenance at liquid nitrogen temperature on T+15 days at 12:37 hrs.

2. Patient Assessment

The member was admitted to hospital on several occasions with progressive complications of pneumonia (with possible aspiration), gastrointestinal bleeding, and renal failure, as well as probable sepsis. The member was placed on the Alcor Watch List in mid-July and was contacted daily. The member deteriorated gradually, became anuric (lack of urine production), and subsequently required IV vasopressor support, including Levophed, at times.

3. Deployment

T-2 days

The member was deteriorating more rapidly than expected. At 10:32 hrs Alcor's Medical Advisor spoke with the member's medical team and called for an immediate Level-1 deployment of Suspended Animation (SA) one of Alcor's strategic partners for providing standby, stabilization and transport (SST) as well as remote blood washout. At 13:58 hrs three SA team members arrive at the hospital.

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.

At 14:11 hrs Alcor's Medical Advisor was informed that the member was stabilizing and was aspirating from his lungs. SA team members were escorted up to the members floor at 14:30 hrs to meet with the attending resident, social worker, charge nurse, risk management and decedent affairs coordinators. By 15:38 hrs the meeting had concluded, and the hospital was given permission by the member's Power of Attorney to allow SA to receive information on the member's status. Additionally, it was decided by risk management that after pronouncement SA would only be allowed to place the patient in the ice bath and apply water ice until outside the hospital, but no cardiopulmonary support or medications administration until then either.

At 15:40 hrs the decedent affairs office informed SA that the member's release from the hospital was noted and on file with security for a quick extrication from the hospital. The member at this time was on high flow oxygen, awake, responding to verbal stimuli but disoriented, and on pressors. He was on IV fluids with an antibiotic for possible urinary tract infection and had little urine output.

The member's family was willing to put the member on comfort care the following morning. At 17:36 hrs the member's vital signs were blood pressure (BP) 99/81, mean arterial pressure (MAP) 89, heart rate (HR) 71, capillary oxygen saturation (SpO_2) 99% on high flow oxygen, and respiration rate (RR) 26. SA would not be allowed to bring equipment to the floor until the member's decline became more imminent, and there would be no overnight visitation.

4. Standby

T-1 days

SA team members arrived at the member's floor at 09:00 hrs to meet with the day shift and make introductions. At 09:30 hrs the member's lungs were clear, the member had no urine output, was on a Dextrose 5% (D5) IV, and was responding to verbal stimuli with moans. The members vitals were BP 99/59, HR 70, SpO_2 94% 6L/min with a mask, and RR 26. Chest X-rays were taken, and the lungs looked clear according to the attending physician.

Alcor's Medical Advisor spoke with the ICU doctor at 16:42 hrs. The patient was not producing urine and there were no plans for dialysis. They were contemplating comfort care which would remove all interventions, including antibiotics. At 17:08 hrs the member was on a heparin drip of 16 units/kg, D10-45% NaCL continuous IV push 50ml/hr., Furosemide 10mg/ml single injection 80mg. The member's vital signs were BP 91/74, HR 75, SpO_2 93%, RR 24.

T-0 days

At 03:30 hrs The SA team was alerted by the hospital staff that the member would be placed on comfort care and their equipment would be permitted to be staged on the member's floor. The hospital staff agreed to hold this order until the SA equipment was on site and ready for use. SA moved their mobile operating vehicle (MOV) to a non-emergency vehicle loading bay. By 04:50 hrs SA had the portable ice bath (PIB) and approximately120 lbs. of water ice ready in the member's room. Two team members went back to the MOV to draw up medications in accordance with the medications protocol for a patient weighing 49.4 kg (see Discussion

section). Comfort care was postponed until the day shift nurses arrived. Two SA team members would remain on the member's floor for the remainder of the standby.

At 07:19 hrs the member was receiving Levophed 4mg and his vitals were BP 107/65, HR 75, SpO2 99%, and RR 25. At 09:00 hrs the member was placed on comfort care with the only intervention being oxygen and Dilaudid 0.5 mg/hr for pain management. At 17:00 hrs the member's vitals were BP 88/57, HR 74, SpO2 100%, and RR 18. The member was moved to the main hospital floor for comfort care, and it was hospital policy to remove oxygen at that time. At 17:25 hrs and the member began agonal breathing.

5. Stabilization

The member went into cardiac arrest at approximately 17:53 hrs and was pronounced legally deceased and released to SA at 17:54 hrs. As there were three SA team members, many steps in the stabilization procedure could be done concurrently. The patient was disconnected from hospital equipment and placed into the portable ice bath (PIB) adjacent to the hospital bed at 17:56 hrs. Approximately 100 lbs. of water ice was added to the PIB to initiate external cooling. The right and left nasopharyngeal temperature (NPT) thermocouples were placed at 17:57 hrs using nasal putty to prevent water and ice from entering the nares and interfering with temperature measurements. The surface conduction cooling device (SCCD) was placed on the patient's face to improve external cooling.

The hospital did not allow the administration of medications, intubation, or activation of the Autopulse chest compression device inside the hospital room. The patient was covered with a privacy drape and moved from the hospital to the mobile operating vehicle (MOV) at 17:58 hrs. The Autopulse was initiated at 18:02 hrs enroute to the MOV. Authorization to perform the stabilization surgery in the loading bay had previously been granted by security.

Inside the MOV, an approximate additional 120 lbs. of water ice were added to the PIB, and the patient was intubated at 18:05 hrs. A ventilator was connected to the airway along with the $ETCO_2$ detector at 18:08 hrs to inform the team about the efficacy of the cardiopulmonary support (CPS) as well as the potential need to adjust treatment such vasopressor administration. The $ETCO_2$ remained at 19.3 throughout the stabilization procedure.

At 18:10 hrs an additional 3 gallons of water were added to the PIB and the SCCD pump was started to circulate water and improve external cooling. Concurrently, an intraosseous (IO) device was placed in the tuberosity of the right leg to access the vasculature and administration of the full medication protocol commenced at 18:11 hrs (see the below Table of Medications Administered for the names of the medications, the doses, and the times of administration). At 18:19 hrs the ventilator was turned on. At 18:44 hrs the Autopulse battery was depleted but was not replaced as surgery was about to begin.

6. Field Surgery and Washout

While still in the PIB, the patient was prepped for surgery and the initial surgical cut for median sternotomy to access the patient's heart was made at 18:47 hrs. The sternum was cut with a Stryker sternal saw. The heart was exposed at 18:52 hrs and a thoracic thermocouple was placed.

The cardiac structures were unremarkable, although it did appear that the tip of a right ventricle pacing lead had eroded through the ventricular wall (but without any associated hemorrhage). Both the left NPT and the right NPT were reading 26°C.

The ascending aorta was cannulated through a purse-string with a 20 French (Fr) curved metal tip cannula at 18:56 hrs, and the right atrium to the inferior vena cava was cannulated through a pursestring with a 27/32 venous dual stage cannula at 19:00 hrs. The cannulae were connected to the cardiopulmonary bypass circuit at 19:10 hrs. The circuit included a room-air aquarium pump set to 5L/min to oxygenate the patient. At 19:11 hrs 250,000 IU of streptokinase were added to the perfusate which was flowing at 2 L/min, with the input flow temperature at 7°C and the return flow at 22°C.

The arterial pressure was set to not exceed 100 mmHg and the oxygenator was turned off. The first 15-liter bladder of MHP-2 was depleted at 19:16 hrs. There was a 15 second hold in flow as the second bladder was connected. The perfusion pressure was set again to 100 mmHg. Recirculation of the perfusate was started at 19:18 hrs.

At 19:28 hrs the heat exchanger pump flow was suboptimal. The diffuser that spreads the flow of water over the ice for the perfusion circuit heat exchanger was clogged. The pump diffuser was cut off at 19:36 hrs and the flow improved. In order to provide better cooling for the heat exchanger, team members diffused the water over the ice with their hands, so it was not a stationary flow of water over the same area of ice.

The patient's chest was closed at 20:45 hrs with stainless steel wire which was stapled to the skin. At Alcor's request the cannulae were left in place and brought out through the top of the incision; they had been disconnected from the pump circuit and were connected together, leaving the cannula exposed for reconnection during cryoprotectant perfusion at Alcor.

At 20:56 the recirculation of perfusate was concluded with both the left and right NPT and the thoracic temperature all at 2°C. The surgeon's report stated that a good washout had resulted, but cooling had been slower than usual.

7. Patient Transport

At 21:30 SA and the patient left the hospital parking lot. An additional 60 lbs. of water ice were added to the PIB. All of the paperwork for transit permits was prepared by the funeral director and was waiting to be submitted to the permit office when it opened the following morning.

T+1 days

The transport plan was to drive the patient to and wait near the Arizona border until the issuance of the transit permit. At 06:20 hrs while stopping for fuel, an additional 60 lbs. of ice was placed on the patient. An additional 60 lbs. of ice were added at 08:00 hrs while waiting for the transit permit. At 09:09 hrs the permit was issued, and the patient was enroute to Alcor. The patient arrived at Alcor at 11:31 hrs.

8. Cryoprotectant Perfusion Surgery at Alcor

The patient arrived in the operating room (OR) at Alcor at 11:37 hrs with both the left and right nasopharyngeal temperatures at 0.3°C. The cryoprotectant perfusion was planned to start with a refractive index (RI) of 11 Brix (3% of M22 perfusate concentration needed to vitrify (CNV)) as it had been more than 18 hours since cardiac arrest.

At 11:53 hrs ice bags were removed from around the patient's head and the patient was extubated. The patient was moved to the OR table and again covered with ice bags. As the cannulae from the washout had been left in place, no additional surgery was required and the existing cannulae were connected to the tubing circuit at 12:19 hrs, saving valuable time.

9. Cryoprotectant Perfusion at Alcor

At 12:19 hrs the arterial pressure was 49 mmHg with a target pressure being set to 80 mmHg. The main pump was on manual control and open circuit perfusion was started. At 12:22 hrs the washout effluent line was clamped, the recirculating cryoprotectant ramp with M22 solution was initiated and placed under computer control. There were 10 liters of perfusate in the washout effluent and 4 liters in the mixing reservoir.

The left burr hole was started at 12:25 hrs and the right burr hole was started at 12:26 hrs. Both burr holes were cleaned and completed at 12:27 hrs. A thermocouple was placed in the right burr hole and stapled to scalp at 12:29 hrs. The venous refractive index (RI) readings on whole body patients are taken from a port in the venous return line. The arterial RI is taken from the mixing arterial line sampling port. The RI readings at 12:34 hrs were 10.84 Brix venous (2.5% CNV) and 14.13 Brix arterial (10.4% CNV). The temperatures were arterial 3.2°C, venous 2.9°C, NPT 1.8°C, burr hole 2.1°C, whole body box 18°C. The arterial pressure was set at 80 mmHg.

The effluent reservoir pump was turned off at 12:36 hrs because the cannulation connections were very tight, and no effluent was being lost to the table. In order to improve cooling, the patient was covered with plastic wrap to seal in the nitrogen gas flowing over the patient, which was turned on at 12:38 hrs. At 12:50 hrs the patient's skin was already tanning from exposure to the vitrification solution. At 13:31 hrs the patient's face was a deep brown, but the chest was only a light orange.

At 13:53 hrs the withdrawal pump to the effluent reservoir was stopped to build volume in the mixing reservoir. At 13:57 hrs the cryoprotectant ramp was stopped to initiate the 30-minute pause. The RI readings were 30.24 Brix venous (49% CNV) and 31:98 Brix arterial (53% CNV). The patient enclosure and chiller were switched to a target temperature of -3°C.

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 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.

At 14:21 hrs the ramp pump was started at full speed. This was done before the full 30 minutes because RI readings showed that patient equilibration was already reached. As the main pump was slowing due to viscosity, the arterial pressure was raised at 14:44 hrs to 100 mmHg to compensate.

The perfusate addition speed was lowered from 7 to 2 at 15:25 hrs to improve equilibration; the pump speed was turned up and down regularly until the end of perfusion to provide a smoother cryoprotection uptake curve.

The cryoprotectant ramp was terminated at 16:48 hrs. The RI readings were 56.79 Brix arterial (112.69% CNV), and 50.93 Brix venous (98.63% CNV). The endpoint goal of 51.5 Brix (100% CNV) from the venous sampling line was not reached as perfusion was terminated at 3 hours after start of perfusion of the highest concentration of M22. The temperatures were arterial -3.4°C, venous -1.9°C, NPT -2.5°C, burr hole -3.1°C, and patient enclosure -5.2°C.

10. Cooling to Liquid Nitrogen Temperature

The patient was disconnected from all lines and equipment at 17:00 hrs and moved into the patient care bay. A computer program was used to initiate cryogenic cooldown at 17:08 hrs on T+1 days, plunging to -110°C and descending thereafter at -1°C/hour to liquid nitrogen temperature. On T+6, an uneventful cooldown was terminated at 11:16 hrs. On T+15, the patient was transferred to long-term maintenance at liquid nitrogen temperature.

During the cooldown, a second patient cooldown was initiated on a separate computer. When the extension was plugged into the second computer, the running cooldown spontaneously shut down (see the Discussion section).

11. Timeline and Time Summaries

Timeline

T-0	17:53	Estimated time of cardiac arrest
T-0	17:54	Time of pronouncement of legal death
T-0	17:56	Start of ice bath cooling
T-0	17:58	Transport patient to MOV to continue stabilization
T-0	18:02	Start of mechanical chest compressions
T-0	18:05	Placement of airway
T-0	18:10	Placement of intraosseous (IO) device
T-0	18:11	Administration of first medication (200 mg propofol))
T-0	18:19	Started ventilation
T-0	18:27	Administration of final medication (20 IU vasopressin)
T-0	18:44	Stopped of cardiopulmonary support (L and R NPT 26°C)
T-0	18:47	Start of field surgery
T-0	19:09	End of field surgery
T-0	19:10	Start of open circuit washout
T-0	19:18	Start of closed circuit perfusion
T-0	20:56	Completion of closed circuit perfusion
T-0	21:30	Departure of transport vehicle to funeral home
T+1	04:10	Start transport of patient to Alcor
T+1	11:37	Arrival of patient at Alcor OR (NPY 0.16°C)
T+1	12:19	Connect cannulae to perfusion circuit at Alcor
T+1	12:22	Start of cryoprotection
T+1	12:25	Start burr hole surgery
T+1	12:27	Complete burr hole surgery
T+1	13:57	Pause at 50% of concentration necessary for vitrification (CNV) achieved
T+1	14:21	Start of sub-zero terminal concentration ramp (off pause)
T+1	16:48	End of cryoprotection (final RI readings: arterial 56.79 Brix, venous 50.93 Brix)
T+1	17:08	Start of cryogenic cooldown
T+6	11:16	Completion of cryogenic cooldown
T+15	12:37	Transfer of patient to long-term maintenance at LN2 temperature

Time Summaries

Event Duration hr:min		days	time	
FIELD STABILIZATION				
00:01	From:	T-0	17:53	Estimated time of cardiac arrest
	Till:	T-0	17:54	Time of pronouncement of legal death
00:03	From:	T-0	17:53	Estimated time of cardiac arrest
	Till:	T-0	17:56	Start of ice bath cooling
00:09	From:	T-0	17:53	Estimated time of cardiac arrest
	Till:	T-0	18:02	Start of mechanical chest compressions
00:18	From:	T-0	17:53	Estimated time of cardiac arrest
	Till:	T-0	18:11	Administration of first medication (200 mg propofol))
00:16	From:	T-0	18:11	Administration of first medication (200 mg propofol))
	Till:	T-0	18:27	Administration of final medication (20 IU vasopressin)
FIELD SURGERY AND WASHOUT				
00:54	From:	T-0	17:53	Estimated time of cardiac arrest
	Till:	T-0	18:47	Start of field surgery
00:22	From:	T-0	18:47	Start of field surgery
	Till:	T-0	19:09	End of field surgery
01:17	From:	T-0	17:53	Estimated time of cardiac arrest
	Till:	T-0	19:10	Start of open circuit washout
01:46	From:	T-0	19:10	Start of open circuit washout
	Till:	T-0	20:56	Completion of closed circuit perfusion
03:03	From:	T-0	17:53	Estimated time of cardiac arrest
	Till:	T-0	20:56	Completion of closed circuit perfusion
CRYOPROTECTANT SURGERY AT ALCOR				
17:44	From:	T-0	17:53	Estimated time of cardiac arrest
	Till:	T+1	11:37	Arrival of patient at Alcor OR (NPY 0.16°C)
00:42	From:	T+1	11:37	Arrival of patient at Alcor OR (NPY 0.16°C)
	Till:	T+1	12:19	Connect cannulae to perfusion circuit at Alcor
00:03	From:	T+1	12:19	Connect cannulae to perfusion circuit at Alcor
	Till:	T+1	12:22	Start of cryoprotection
CRYOPROTECTANT PERFUSION AT ALCOR				
18:29	From:	T-0	17:53	Estimated time of cardiac arrest
	Till:	T+1	12:22	Start of cryoprotection
00:45	From:	T+1	11:37	Arrival of patient at Alcor OR (NPY 0.16°C)
	Till:	T+1	12:22	Start of cryoprotection
04:29	From:	T+1	12:19	Connect cannulae to perfusion circuit at Alcor
	Till:	T+1	16:48	End of cryoprotection (final RI readings: arterial 56.79 Brix, venous 50.93
04:26	From:	T+1	12:22	Start of cryoprotection
	Till:	T+1	16:48	End of cryoprotection (final RI readings: arterial 56.79 Brix, venous 50.93

CRYOGENIC COOLDOWN AT ALCOR				
00:20	From:	T+1	16:48	End of cryoprotection (final RI readings: arterial 56.79 Brix and venous
	Till:	T+1	17:08	Start of cryogenic cooldown
23:15	From:	T-0	17:53	Time of cardiac arrest
	Till:	T+1	17:08	Start of cryogenic cooldown
05:31	From:	T+1	11:37	Arrival of patient at Alcor OR (NPY 0.16°C)
	Till:	T+1	17:08	Start of cryogenic cooldown

12. Table of Medications Administered

T-0 days

TIME	MEDICATION	DOSE	PURPOSE
18:11 hrs	Propofol	200 mg	Anesthetic; reduces cerebral metabolic demand; reduces the theoretic possibility of increased awareness during aggressive CPS.
18:11 hrs	Heparin	50,000 IU	Anticoagulant; prevents blood clot formation.
18:11 hrs	Antacid	250 cc total (1st dose 60 cc) Note 1	A buffer used to protect the stomach from acid erosion.
18:12 hrs	Sodium citrate	50 cc total Note 2	Anticoagulant; prevents blood clot formation.
18:12 hrs	Antacid	250 cc total (2nd dose 60 cc) Note 1	A buffer used to protect the stomach from acid erosion.
18:13 hrs	Antacid	250 cc total (3rd dose 60 cc) Note 1	A buffer used to protect the stomach from acid erosion.
18:13 hrs	Vasopressin	40 IU Total (1st dose 20 IU) Note 3	Vasopressor; increases blood pressure during CPS.
18:13 hrs	Minocycline	200 mg	Antibiotic and neuroprotectant
18:14 hrs	Antacid	250 cc total (4th dose 60 cc) Note 1	A buffer used to protect the stomach from acid erosion.
18:14 hrs	Decaglycerol/THAM	400 cc total (1st dose 60 cc) Note 4	Decaglycerol inhibits cerebral edema.
18:14 hrs	Antacid	250 cc total (5th dose 10 cc) Note 1	A buffer used to protect the stomach from acid erosion.
18:15 hrs	Decaglycerol/THAM	400 cc total (2nd dose 60 cc) Note 4	Decaglycerol inhibits cerebral edema.

18:16 hrs	Decaglycerol/THAM	400 cc total (3rd dose 60 cc) Note 4	Decaglycerol inhibits cerebral edema.
18:16 hrs	Decaglycerol/THAM	400 cc total (4th dose 20 cc) Note 4	Decaglycerol inhibits cerebral edema.
18:16 hrs	Vital Oxy (w/ saline)	70 cc total Note 5	Antioxidants: melatonin, vitamin E (D-alpha tocopherol), PBN (alpha Phenyl t-Butyl Nitrone) and anti-inflammatory carprofen.
18:21 hrs	Decaglycerol/THAM	400 cc total (5th dose 60 cc) Note 4	Decaglycerol inhibits cerebral edema.
18:22 hrs	Decaglycerol/THAM	400 cc total (6th dose 60 cc) Note 4	Decaglycerol inhibits cerebral edema.
18:23 hrs	Decaglycerol/THAM	400 cc total (7th dose 60 cc) Note 4	Decaglycerol inhibits cerebral edema.
18:24 hrs	Decaglycerol/THAM	400 cc total (8th dose 20 cc) Note 4	Decaglycerol inhibits cerebral edema.
18:25 hrs	SMT (S-methyl-isothiourea)	400 mg Note 6	Neuroprotectant (iNOS inhibitor); protects the brain from ischemic injury; raises blood pressure.
18:27 hrs	Vasopressin	40 IU Total (2nd dose 20 IU) Note 3	Vasopressor; increases blood pressure during CPS.
19:11 hrs	Streptokinase	250,000 IU Note 7	A thrombolytic used to break up existing blood clots.

Notes:

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

2. 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 received 20 grams of sodium citrate because his weight was over 40 kg. See the discussion section.

3. 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.

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).

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

7. Streptokinase, 250,000 IU was administered during open circuit perfusion in the field.

13. Discussion

Standby

The risk assessment department at the hospital refused to allow any medical equipment into the hospital on our portable ice bath (PIB). This led to organizational issues upon loading the patient into the mobile operating vehicle (MOV) and commencing with the initial stabilization. Normally all stabilization equipment and medications are organized and attached to the PIB but in this case the equipment had to remain in the vehicle. Due to the tight confines of the vehicle much of the equipment needed to remain stored until the PIB could be locked in place. This created delays in performing some of the required tasks for stabilization.

The hospital risk assessment office also denied Suspended Animation's (SA) request to perform any initial stabilization procedures in the patient's room. They would allow the transfer to the PIB and application of water ice. This is a situation that is implemented by the facility where the member is receiving care. Open conversation with the floor medical providers will sometimes allow additional stabilization services to be implemented, but in this case the hospital staff held firm.

Stabilization

The medications were pre-drawn the morning prior to the cardiac arrest and placed in a cooler with water ice to stay cool. Because no medications were allowed in the hospital, the medications remained in the cooler in the mobile operating vehicle (MOV) until the start of medication administration. As the medications could not be pre-organized into the medication syringe rack, the sodium citrate was delivered third, after heparin, and the SMT was delivered after the second round of Decaglycerol. Additionally, one of the 50cc Sodium Citrate doses was not retrieved from the cooler and only a half dose was administered. Due to the patient's low body weight this did not alert the administering team member to look for the additional half dose. If this situation happens in the future additional time will be taken to organize the medications prior to administration.

Because the hospital did not allow SA to start any procedures other than to put the patient into the portable ice bath and move the patient out of the hospital, the automated ventilator was not switched on until 10 minutes after intubation. Once in the MOV the limited room and organizational capabilities lead to a more difficult initial stabilization. The urgency for

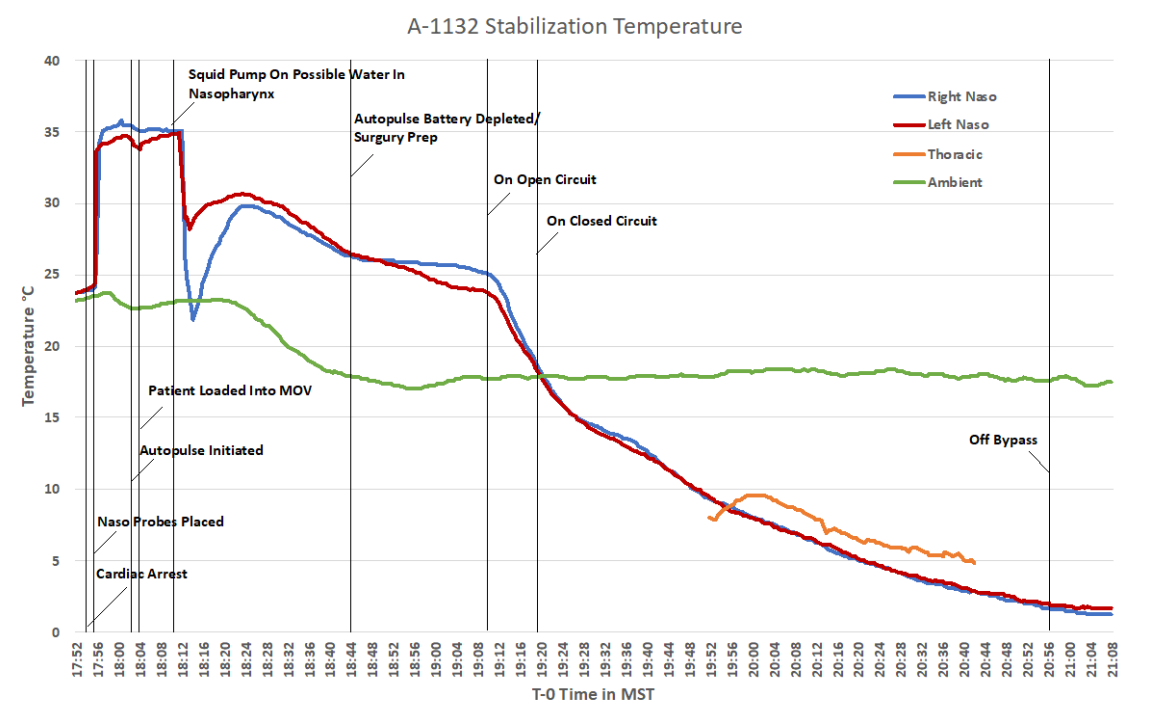
positive pressure ventilations to be initiated immediately will be reviewed and stressed at the next training.

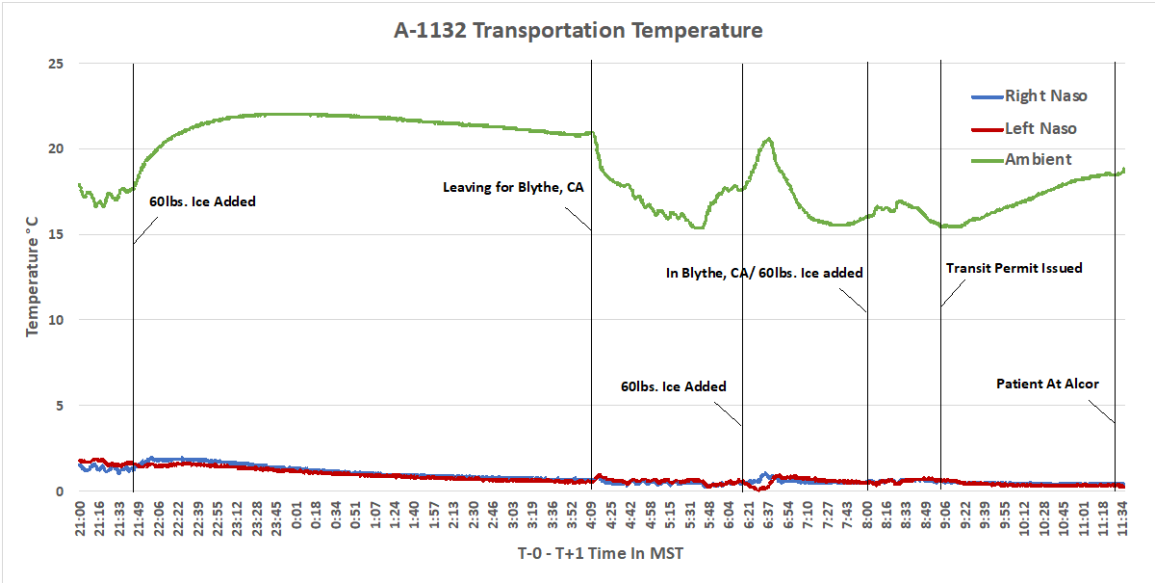
Cryogenic Cooldown

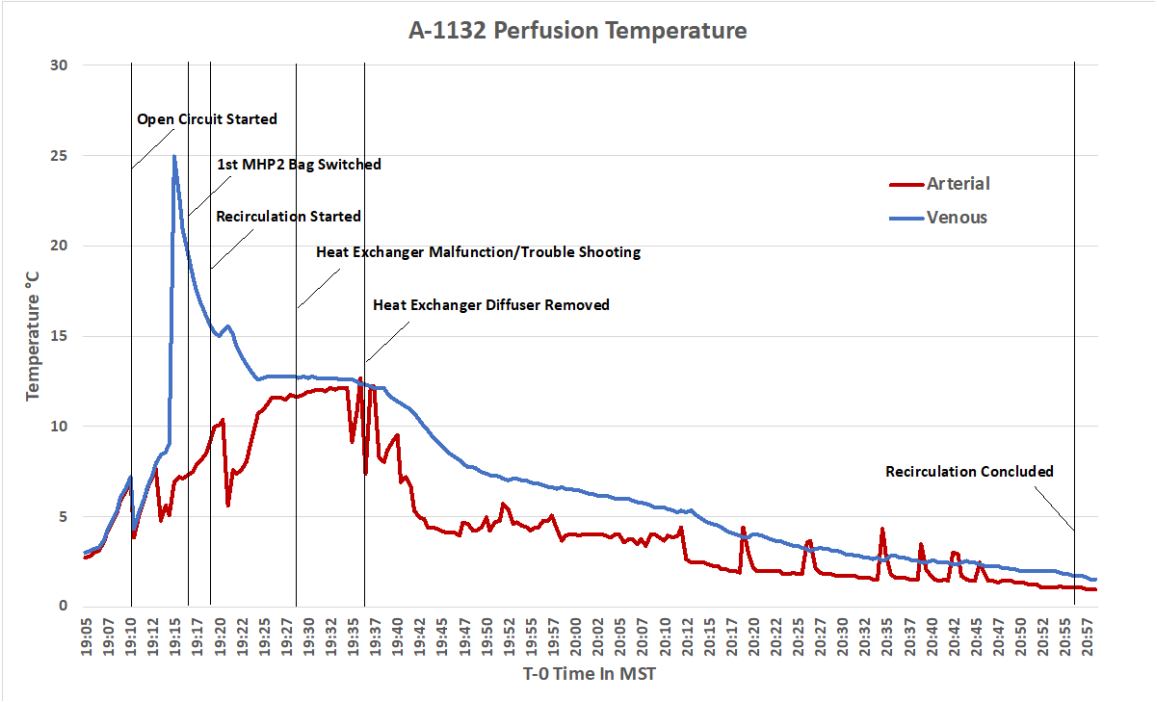
During the cooldown, a second patient cooldown was initiated on a separate computer. Cooldown systems connect to a building-wide alarm system via a DC output port. When multiple cooldowns are running the systems are connected in parallel so anyone can activate the building alarm. In this instance, when the extension was plugged in to the second computer, the running cooldown spontaneously shut down. The suspected cause of the problem was a static discharge into the electronics when the plug was connected. It was discovered that the older cooldown system did not share a common ground between the cart enclosure and the electronics, which may have enabled a static charge to exist. A ground tie was made, and team members are advised to touch the metal enclosure to discharge static before connecting any plugs.

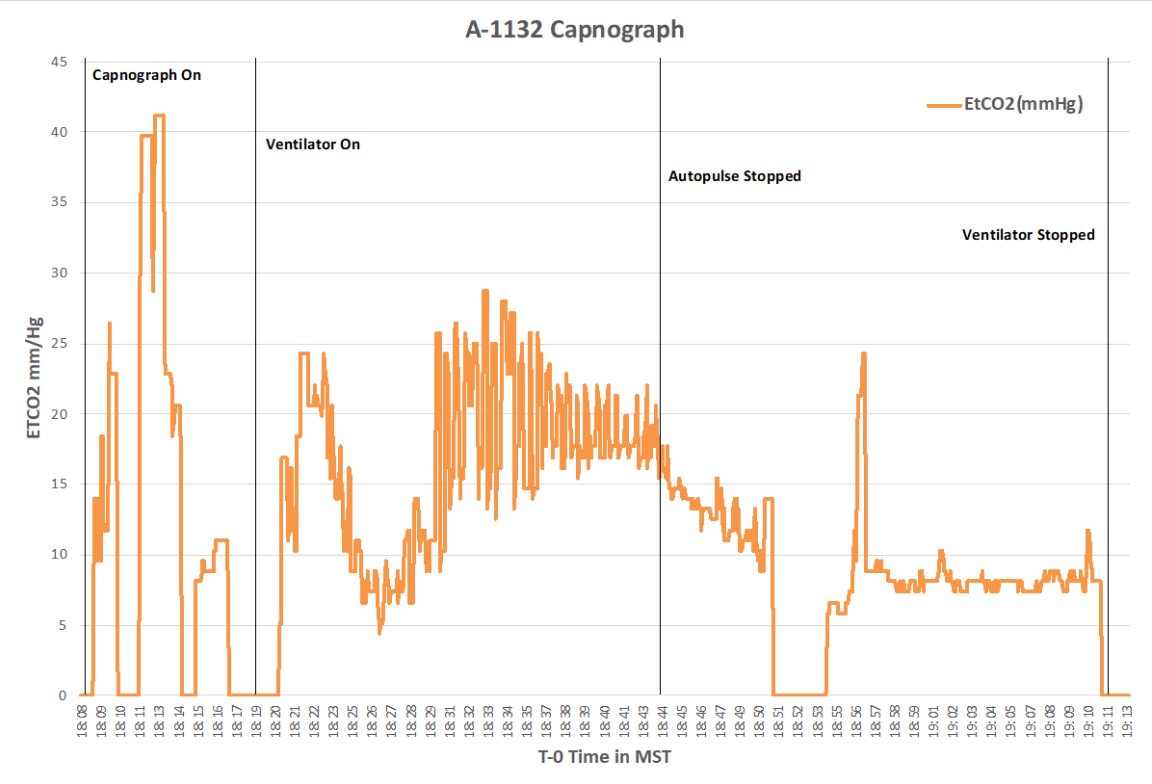
14. Cryoprotection and Temperature Graphs

Graphs Provided by SA:

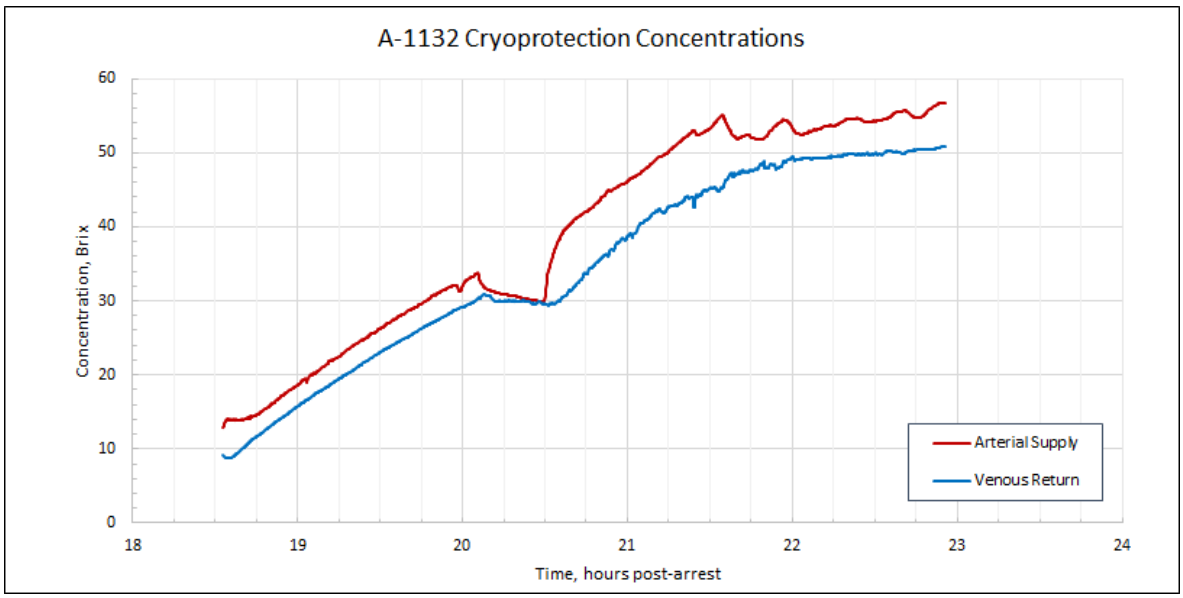


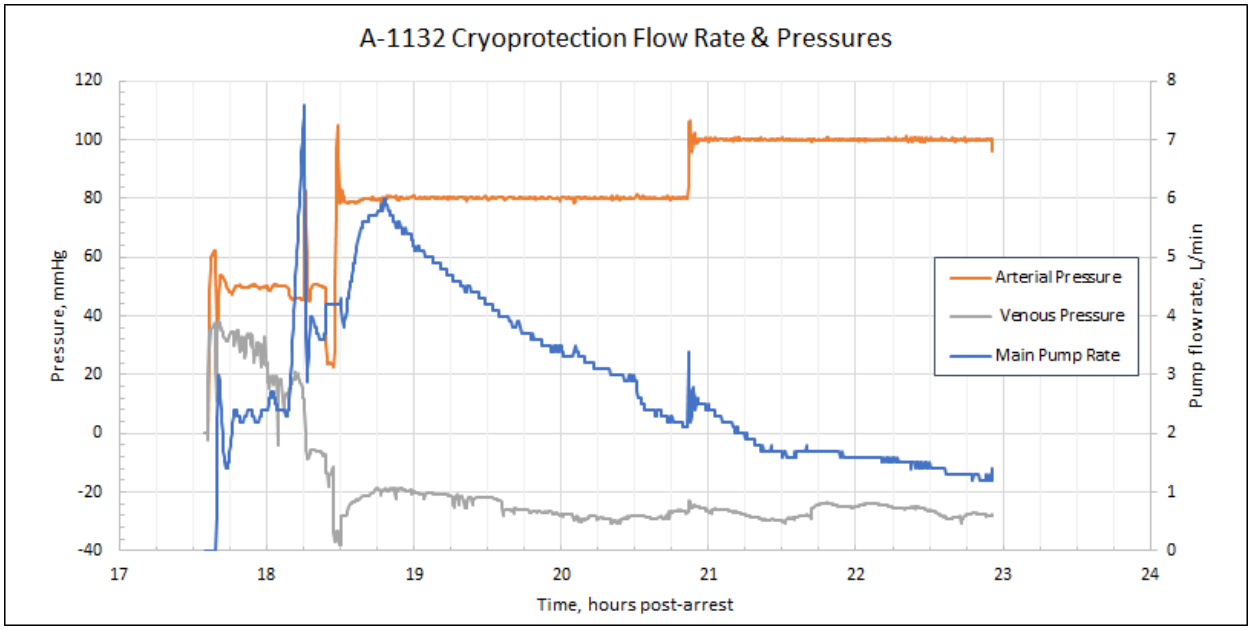

A-1132 Transportation Temperature
Temperature °C
T-0 - T+1 Time In MST
Right Naso
Left Naso
Ambient
60lbs. Ice Added
Leaving for Blythe, CA
In Blythe, CA/ 60lbs. Ice added
Transit Permit Issued
60lbs. Ice Added
Patient At Alcor

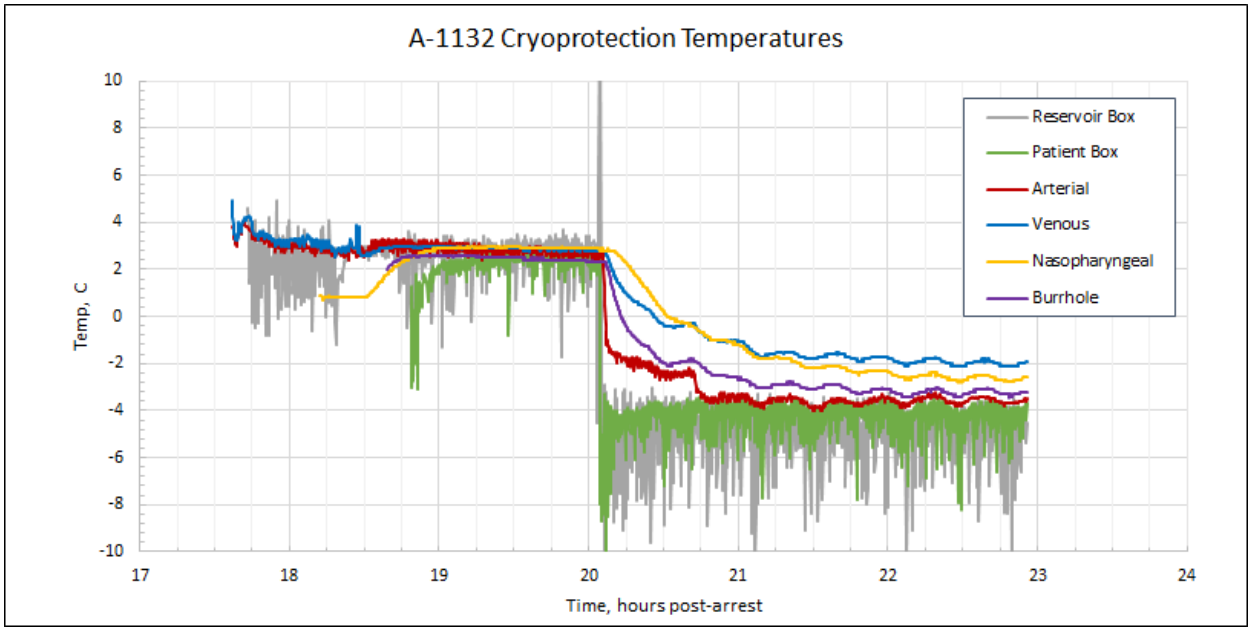

A-1132 Perfusion Temperature
Temperature °C
T-0 Time In MST
Arterial
Venous
Open Circuit Started
1st MHP2 Bag Switched
Recirculation Started
Heat Exchanger Malfunction/Trouble Shooting
Heat Exchanger Diffuser Removed
Recirculation Concluded

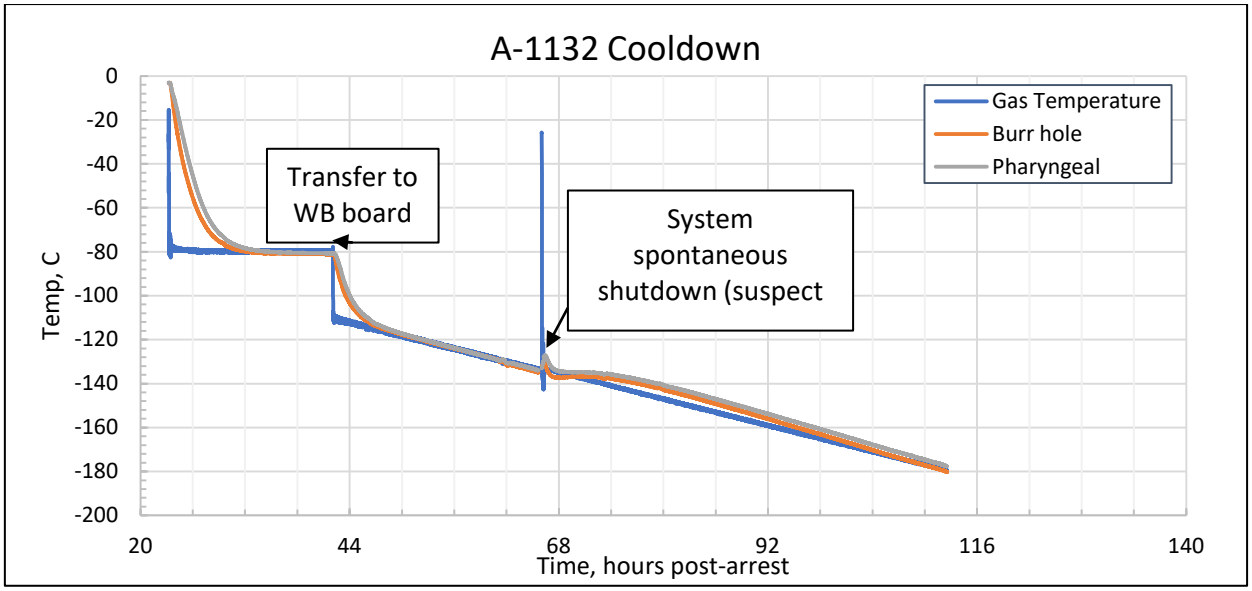


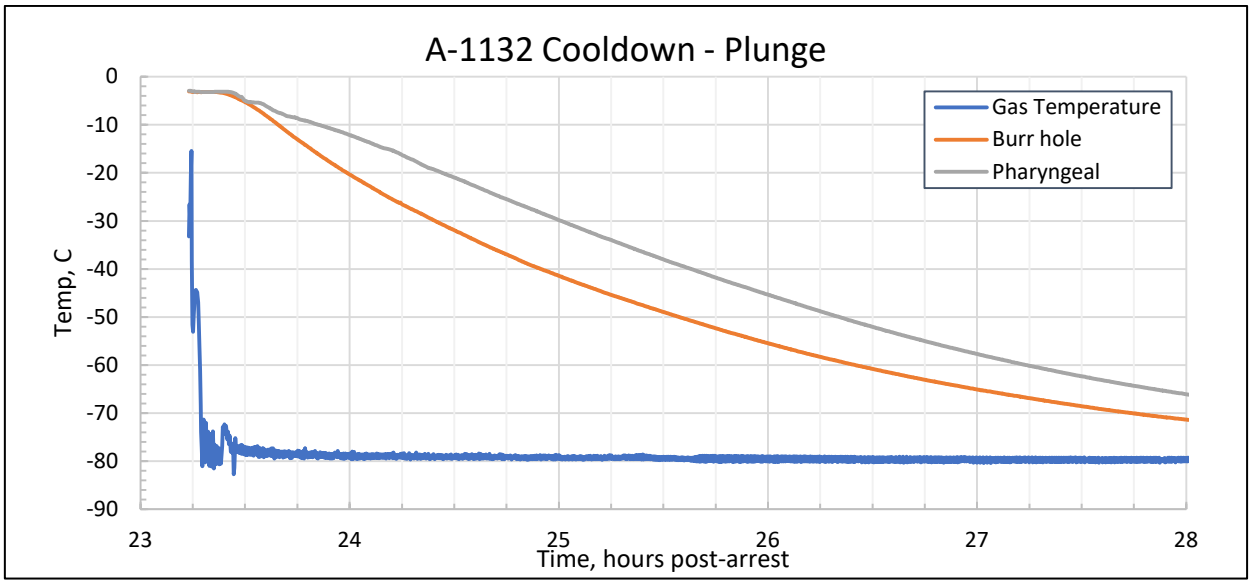
Graphs provided by Alcor:

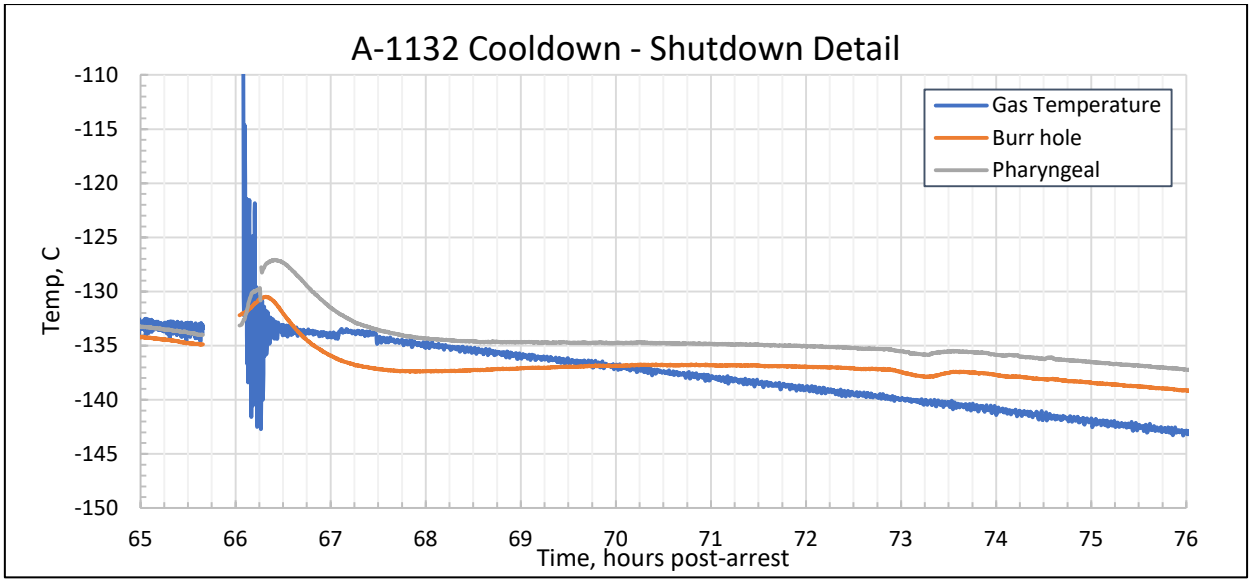



A-1132 Cryoprotection Flow Rate & Pressures
Pressure, mmHg
Pump flowrate, L/min
Time, hours post-arrest
Arterial Pressure
Venous Pressure
Main Pump Rate


A-1132 Cryoprotection Temperatures
Temp, C
Time, hours post-arrest
Reservoir Box
Patient Box
Arterial
Venous
Nasopharyngeal
Burrhole


A-1132 Cooldown
Temp, C
0
-20
-40
-60
-80
-100
-120
-140
-160
-180
-200
20
44
68
92
116
140
Time, hours post-arrest
Gas Temperature
Burr hole
Pharyngeal
Transfer to WB board
System spontaneous shutdown (suspect


A-1132 Cooldown - Plunge
Temp, C
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
23
24
25
26
27
28
Time, hours post-arrest
Gas Temperature
Burr hole
Pharyngeal


A-1132 Cooldown - Shutdown Detail
Temp, C
-110
-115
-120
-125
-130
-135
-140
-145
-150
65
66
67
68
69
70
71
72
73
74
75
76
Time, hours post-arrest
Gas Temperature
Burr hole
Pharyngeal

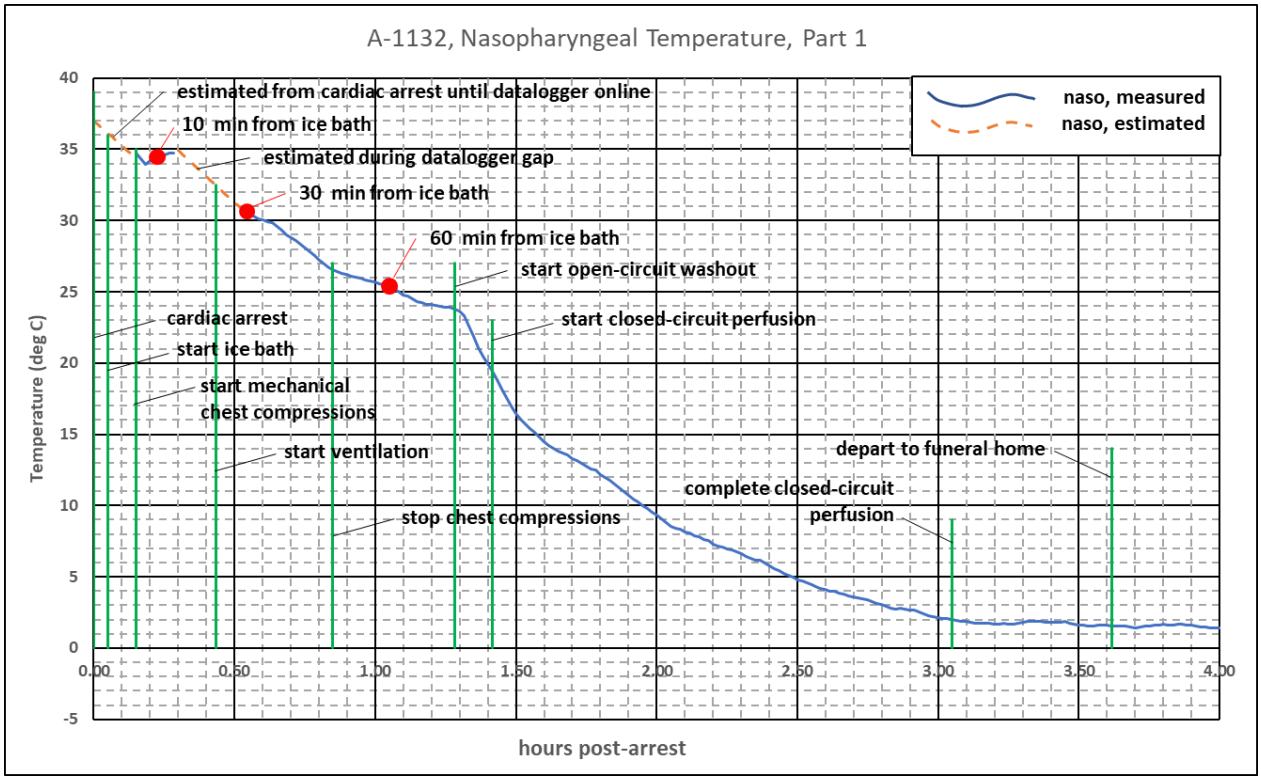
15. S-MIX

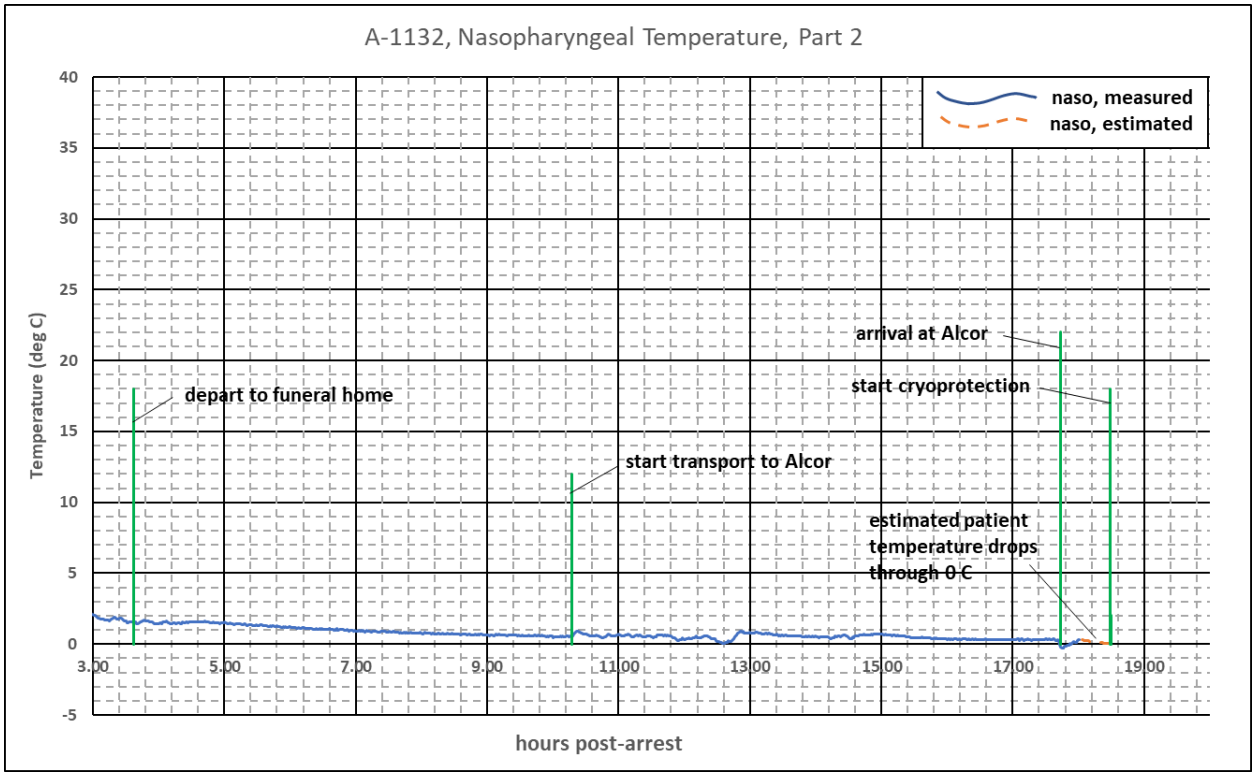
The Standardized Measure of Ischemic Exposure (S-MIX) expresses the total ischemic exposure prior to the start of cryogenic cooling as the equivalent duration of normothermic ischemia. An S-MIX of 00:00 (hh:mm) is the ideal case of no ischemic damage. The higher the S-MIX time, the more damage. Factors 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 18:30. As shown below, and due to lowering of the body temperature, S-MIX duration is shorter, at 01:56.

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	17:53	00:00	23.9			
	seg 1		00:03	00:03	10.1	no	no	00:03
Start of ice bath cooling		T-0	17:56	00:03	34.0			
	seg 2		00:06	00:06	0.7	no	no	00:05
Start of mechanical chest compressions		T-0	18:02	00:09	34.7			
	seg 3		00:17	00:17	-4.7	no	no	00:14
Started ventilation		T-0	18:19	00:26	30.1			
	seg 4		00:25	00:25	-3.5	yes	no	00:07
Stopped of cardiopulmonary support		T-0	18:44	00:51	26.6			
	seg 5		00:26	00:26	-2.8	no	no	00:11
Start of open circuit washout		T-0	19:10	01:17	23.8			
	seg 6		00:08	00:08	-5.0	no	yes	00:00
Start of closed circuit perfusion		T-0	19:18	01:25	18.8			
	seg 7		01:38	01:38	-16.9	no	yes	00:00
Completion of closed circuit perfusion		T-0	20:56	03:03	1.9			
	seg 8		00:34	00:34	-0.4	no	no	00:03
Departure of transport vehicle to funeral home		T-0	21:30	03:37	1.5			
	seg 9		06:40	06:40	-1.0	no	no	00:33
Start transport of patient to Alcor		T+1	04:10	10:17	0.6			
	seg 10		07:27	07:27	17.2	no	no	00:36
Arrival of patient at Alcor operating room		T+1	11:37	17:44	17.7			
	seg 11		00:45	00:45	-17.4	no	no	00:03
Start of cryoprotection		T+1	12:22	18:29	0.3			
	seg 12		00:01	00:01	0.0	no	no	00:00
Estimated temperature thru 0 C		T+1	12:23	18:30	0.3			
totals:			18:30	18:30	-23.6			01:56

The below plots show events related to the S-MIX calculation. The red dots provide a metric for how fast the patient is cooled. 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				
Note: time = 0 at start of ice bath	0 min elapsed	10 min elapsed	30 min elapsed	60 min elapsed
Naso temperature (°C)	36.1	34.3	30.3	25.5
Temperature drop (°C) from t = 0	0.0	-1.8	-5.8	-10.6
Cooling rate (°C/min) from t = 0	N/A	-0.18	-0.19	-0.18





16. CT Scans

As this was a whole-body cryopreservation, no post-cryopreservation CT scans were obtained.