Alcor A-3525

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-3525 was a 58-year-old male with whole body cryopreservation arrangements. The membership contracts were signed just 20 days before his cryopreservation. The cause of death was lung cancer with metastases to the kidneys. The member was pronounced legally deceased in Florida at 13:02 hrs on T-0 days in 2022.

After stabilization and field washout, the patient was air transported to Alcor for cryoprotectant perfusion and cryogenic cooldown. The patient arrived at Alcor on T+1 days. Cryoprotectant perfusion was attempted but no flow could be established; to prevent further damage to the patient this became a straight freeze operation. The cryogenic cooldown was initiated at 17:56 hrs on T+1 days and terminated at 00:32 hrs on T+7 days. The patient was transferred to long-term care at liquid nitrogen temperature on T+20 days at 15:00 hrs.

2. Patient Assessment and Deployment

The member's family completed the signup process that the member initially started but became too ill to complete. The member was in the hospital on high flow oxygen with a diagnosis of stage IV renal cell carcinoma and acute respiratory failure. The member had been in the hospital for several weeks with progressive complications of terminal kidney cancer. Ventilator support was required as well as both a thoracentesis (a procedure to remove fluid from the thin layer of tissue, or pleura, lining the lung) and a subsequent chest tube for the build-up of excess fluid, and IV vasopressor support (to constrict the blood vessels to raise mean arterial pressure) for over a week.

T-14 days

Alcor's Medical Response Director (MRD) received an urgent call from the member's family at 21:28 hrs reporting that hospital personnel had called to say the member could die any moment and Alcor personnel should be on site as soon as possible. The member was receiving a maximum (no specific details) dosage of multiple vasopressors, including levophed, and was intubated and receiving maximum ventilator oxygen (more specific details not available).

The MRD immediately deployed Suspended Animation, Inc. (SA), one of Alcor's strategic partners for providing standby, stabilization and transport (SST) as well as field washout for this Level-1 emergency.

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

3. The First Standby and Follow-up Patient Assessment

T-13 days

The SA team flew from California to Florida, stopped at their Florida facility to pick up their Mobile Operating Vehicle (MOV) and then drove it to the member's location. The member's family called at 18:16 hrs with an update that the member was still on vasopressors and intubated for oxygen. Overnight the hospital IV pump had cracked and leaked the vasopressors onto the floor, but the member was still relatively stable. The SA team arrived after strict visiting hours were over and were not able to be at the member's bedside until the next day.

T-12 days

The SA team arrived at the member's room at 11:03 hrs. The member appeared to have improved slightly and was still on vasopressors as well as propofol for sedation and fentanyl for pain management.

At 11:12 hrs the SA team received permission for SST equipment to be positioned in the members room, and authorization to park the MOV in the patient loading bay where the stabilization procedure could be performed. There was no authorization given to perform any procedures in the member's room after pronouncement. The member was on minimal ventilator settings and a spontaneous breathing trial was scheduled for the following day. The family was optimistic about the member's chances for recovery and was opting to provide any and all care to the member as long as there was a slight chance for extubation and improvement.

After speaking with the funeral director, no problems with the death certificate and transit permits were anticipated.

T-11 days

The member was taken off of one of the vasopressors, but was retaining fluid, so a diuretic had been prescribed. The hospital planned to do a spontaneous breathing trial (SBT) later that today, but it was again rescheduled for the following day. At 18:11 hrs the member was dialyzed due to the lack of response to the diuretic.

As the member was responding well to his medical care, at 20:00 hrs the Standby was officially terminated, and SA was deployed to a more emergent member (A-3523), also in Florida.

T-8 days

The member was cut back to only one vasopressor and had not yet passed the spontaneous breathing trial, but the family still planned to provide any care necessary to aid in the member's chances of recovery.

T-7 days

The member's white blood count (WBC) had jumped from 18,000 to 26,000. Blood cultures were done, and additional antibiotics prescribed. With the higher WBC and lower blood pressure, another spontaneous breathing trial was not attempted.

T-3 days

The member was placed back on two vasopressors.

T-2 days

The member was still intubated, still on two vasopressors, and receiving continuous renal replacement therapy.

4. The Second Standby

T-1 days

This was day 14 of intubation for the member. The hospital would not provide tracheostomy, an opening in the windpipe to help a patient breath, as an option. Due to increasing vasopressors and worsening respiratory and metabolic acidosis, the SA team was again officially deployed at 14:11 hrs. The family was comfortable with withdrawal of care once the full SA team was on location.

T-0 days

The family and hospital were now allowing SA to take and set up equipment in the member's room and to do stabilization there. At 06:44 hrs it was confirmed that the local funeral home had all the necessary paperwork in place and a Ziegler case for transport. SA arrived at a local hotel to meet with the surgeons and draw up the stabilization medications at approximately 07:05 hrs. The medications were prepared for a patient weighing approximately 155 lbs.

Upon arrival of the SA team, the family asked the hospital for withdrawal of standard care and at 12:01 hrs the member was switched to comfort care. SA did not have access to the member's room as the family wanted privacy. It is estimated that the member went into cardiac arrest at 13:00 hrs and was pronounced legally deceased at 13:02 hrs.

5. Stabilization

The patient was released to SA immediately after pronouncement of legal death and with three team members, many of the stabilization procedures could be performed concurrently (stabilization would have been initiated sooner except that the family was still in the room). At 13:04 hrs the patient was transferred to the portable ice bath (PIB) and covered with 100 lbs. of ice to start external cooling and mechanical cardiopulmonary support (CPS) using the AutoPulse compression device to improve cooling and ventilate the patient's lungs. Left and right nasal thermocouples were placed and stapled in place at 13:05 hrs. Nasal wax was placed around the thermocouples to prevent water from entering the nose and compromising temperature readings.

Concurrently at 13:05 hrs the administration of stabilization medications was initiated (see the below Table of Medications Administered for the names of the medications, doses, and the

times of administration). Internal jugular vein IV access, which had been left in place and kept patent by the hospital staff, was used to begin medication administration. The initial nasopharyngeal temperatures (NPT) were: left 36°C and right 35°C.

The patient was covered with a privacy drape at 13:06 hrs and Tegaderm was applied to the endotracheal tube to prevent water from entering the mouth. At 13:07 hrs a ventilator was attached to the airway and turned on. A Capnograph was attached to the airway to obtain end tidal CO_2 ($EtCO_2$) readings to record the efficiency of the cardiopulmonary support efforts.

The face mask for the surface conduction cooling device (SCCD) was placed on the patient at 13:12 hrs but could not be turned on until the patient was outside the hospital. At 13:13 hrs the patient was covered and transported to the MOV in the loading bay where prior authorization had been granted by the hospital to perform the stabilization procedures. The patient was loaded into the MOV at 13:17 hrs where the medications were concluded and the presurgical cooling continued in the PIB with the addition of 2 gallons of water and 100 lbs. of water ice. The SCCD pump was turned on and flow to the face mask was started.

At 13:46 hrs the AutoPulse battery was depleted. Manual CPS was used while the battery was replaced. Mechanical CPS was restarted within one minute. The patient's nasopharyngeal temperature (NPT) was 26°C at 13:56 hrs; the AutoPulse was shut off to allow preparation of the surgical site.

6. Field Surgery and Washout

Surgery was performed while the patient remained in the PIB. Surface cooling continued until at 14:00 hrs the nasopharyngeal temperature (NPT) reached 25°C. The AutoPulse was stopped, the patient was prepped, and sterile drapes were placed. At 14:03 hrs the first incision was made in the chest for a median sternotomy. A sternal saw was used to divide the sternum. The pericardium was opened, and the surgeon noted that the cardiac structures were normal.

The aorta was cannulated at 14:12 hrs with a 21 French (Fr) curved tip aortic cannula through a purse string. The right atrial appendage was cannulated at 14:16 hrs with a 37/29 dual stage venous cannula through a purse string. At 14:19 hrs the washout circuit was primed and connected to the cannulae. The circuit included an air pump delivering 5L/min room air into the membrane oxygenator and the perfusate was being delivered under the 100mmHg pressure threshold.

At 14:30 hrs closed-circuit recirculation was initiated to continue lowering the patient's temperature. At 15:11 hrs the closed-circuit recirculation was terminated. The patient's NPT was 4°C with a thoracic temperature of 5°C. The cardiac cannulae were sealed by looping 3/8" tubing from the venous to the arterial and the patient's chest was closed at 15:23 hrs, leaving the cannulae exposed to make cannulation later at Alcor easier and faster (see the Discussion section).

7. Patient Transport

At 15:48 hrs the SA team and the patient were on their way to the funeral home in the MOV. At 17:12 hrs the patient was transferred into two layers of body bags inside the metal Zeigler case. Approximately 150 lbs. of water ice was applied to the patient. The Zeigler case was insulated with R-19 fiberglass insulation at 17:20 hrs. The patient was then placed in a cooler room at the funeral home which was at 6°C. At 17:56 hrs the transit permit was issued, and the patient was booked on a commercial airline with a departure scheduled for the following day at 07:30 hrs.

T+1 days

The patient was delivered to the airline cargo department by the funeral director at 05:30 hrs. The departure was delayed from 07:30 hrs to 08:55 hrs with an estimated time of arrival in Phoenix at 13:55 hrs (see the Discussion section). Upon arrival in Phoenix the patient was released from air cargo at 15:39 hrs and was picked up by the Arizona funeral director and driven to Alcor.

8. Cryoprotectant Surgery at Alcor

The patient arrived outside of Alcor at 16:12 hrs. and was brought into the Alcor operating room (OR) at 16:16 hrs. Ice bags were removed from around the patient in order to find the data logger which had shifted during transport. At 16:21 hrs a hoist was used to remove the whole-body patient from the shipper and move the patient to the OR table. The data logger was found under the patient and the initial nasopharyngeal temperature (NPT) reading was 0.4°C. Ice packs were again placed around patient at 16:25 hrs.

The perfusion circuit tubing was clamped at 16:29 hrs and prepared for connection to the cannulae that had been left in place following the field washout (see the Discussion section). At 16:33 hrs the arterial tubing was connected first and bubbles were cleared from the tubing.

9. Cryoprotectant Perfusion at Alcor

The arterial tubing was opened to perfusion flow at 16:42 hrs, with an initial cryoprotectant concentration of 12 Brix due to the long, cold ischemic delay at the remote airport (see the Discussion section). Initial arterial pressure was 27 mmHg rising toward a target pressure of 80 mmHg.

The cryoprotectant ramp was initiated at 16:46 hrs and on computer control. One scalp incision was made for the burr holes at 16:48 hrs. It was noted at 16:49 hrs that abdominal distension had formed rapidly. The arterial pressure was reduced to 20 mmHg while the surgeon checked the chest opening for evidence of what was causing the distension. No immediate problem was

identified. The open chest had temporarily relieved perfusion backpressure and abdominal distension. With no obvious problem to correct, at 16:55 hrs the arterial pressure was increased back to 80 mmHg and the scalp incision for second burr hole was made.

The main pump was slowing down at 16:57 hrs due to backpressure within the patient. Using a Codman perforator and distilled water to cool the scalp and perforator, the left burr hole was completed at 16:58 hrs. The right burr hole was completed at 17:00 hrs. A temperature thermocouple was placed in left burr hole and sutured to the scalp at 17:01 hrs.

Major perfusate flow from both burr holes and the chest cavity was observed. The chest cavity was being suctioned, but there was also a large amount of flow from the burr holes. Major brain edema was possible if perfusion was continued (see the Discussion section), and since there was no venous effluent return and edema was increasing, at 17:07 hrs perfusion was terminated. The main pump was turned off to prevent further damage to the brain. The decision was made by OR personnel to move the patient into the Patient Care Bay and do a straight freeze procedure to halt further damage (see the Discussion section).

At 17:08 the lead perfusionist noted that when perfusion started there were 14 liters of perfusate in the mixing reservoir. When the patient started leaking from the burr holes and chest cavity, another 6 liters of perfusate were added to the reservoir. All but 3 liters remained in the mixing reservoir and the remainder leaked onto the table before the pump was stopped.

10. Cooling to Liquid Nitrogen Temperature

The cannulae and all lines were removed from the patient. The patient was moved into the Patient Care Bay at 17:38 hrs. Cryogenic cooldown was initiated at 17:55 hrs.

A computer program was used to initiate cryogenic cooldown at 17:56 hrs on T+1 days, plunging to -80°C and descending thereafter at -1°C/hour to liquid nitrogen temperature.

On T+4 days at 16:00 hrs the gas control thermocouple in the cooldown dewar was found to be in contact with the patient backboard. Excess liquid nitrogen injections had cooled the patient past -130°C when the setpoint was -84°C. A new probe was connected to the gas control plug (see Discussion section). Once the control temperature was remedied and the patient temperature stopped dropping, the control file was advanced to -133°C to prevent rewarming the patient.

Cryogenic cooldown was terminated at 00:32 hrs on T+7 days. On T+20 days at 15:00 hrs, the patient was transferred to long-term care at liquid nitrogen temperature.

11. Timeline and Time Summaries

Timeline

T-0	13:02	Cardiac arrest and pronouncement of legal death
T-0	13:04	Start of ice bath cooling
T-0	13:04	Start of chest compressions
T-0	13:04	IV left in place by hospital
T-0	13:04	Placement of airway (estimated)
T-0	13:05	Administration of first medication (200 mg propofol)
T-0	13:17	Transport patient to location of surgery
T-0	13:20	Administration of final medication (final 40 units of vasopressin)
T-0	13:56	Termination of CPS (LNPT 27°C)
T-0	14:03	Start of field surgery
T-0	14:18	End of field surgery estimated)
T-0	14:19	Start of open circuit washout
T-0	14:30	Start of closed circuit perfusion
T-0	15:11	Completion of closed circuit perfusion
T+1	05:30	Patient checked into air cargo
T+1	16:16	Arrival of patient in Alcor OR (initial NPT 0.4°C)
T+1	16:33	Connection of existing cannulae to OR tubing
T+1	16:42	Start of open-circuit perfusion
T+1	16:45	Completion of open-circuit washout (estimate)
T+1	16:46	Start of cryoprotectant ramp
T+1	16:48	Start of burr hole surgery
T+1	17:00	Completion of burr hole surgery
T+1	17:07	Termination of cryoprotection (no BRIX reading)
T+1	17:56	Start of cryogenic cooldown
T+7	00:32	Completion of cryogenic cooldown
T+20	15:00	Transfer of patient to long-term maintenance at LN2 temperature

Time Summaries

Event Duration hr:min		days	time	
FIELD STABILIZATION				
0:02	From:	T-0	13:02	Cardiac arrest and pronouncement of legal death
	Till:	T-0	13:04	Start of ice bath cooling
0:02	From:	T-0	13:02	Cardiac arrest and pronouncement of legal death
	Till:	T-0	13:04	Start of chest compressions
0:03	From:	T-0	13:02	Cardiac arrest and pronouncement of legal death
	Till:	T-0	13:05	Administration of first medication (200 mg propofol)
0:15	From:	T-0	13:05	Administration of first medication (200 mg propofol)
	Till:	T-0	13:20	Administration of final medication (final 40 units of vasopressin)
FIELD SURGERY AND WASHOUT				
1:01	From:	T-0	13:02	Cardiac arrest and pronouncement of legal death
	Till:	T-0	14:03	Start of field surgery
0:15	From:	T-0	14:03	Start of field surgery
	Till:	T-0	14:18	End of field surgery estimated)
1:17	From:	T-0	13:02	Cardiac arrest and pronouncement of legal death
	Till:	T-0	14:19	Start of open circuit washout
0:52	From:	T-0	14:19	Start of open circuit washout
	Till:	T-0	15:11	Completion of closed circuit perfusion
2:09	From:	T-0	13:02	Cardiac arrest and pronouncement of legal death
	Till:	T-0	15:11	Completion of closed circuit perfusion
CRYOPROTECTANT SURGERY AT ALCOR				
27:14	From:	T-0	13:02	Cardiac arrest and pronouncement of legal death
	Till:	T+1	16:16	Arrival of patient in Alcor OR (initial NPT 0.4°C)
0:17	From:	T+1	16:16	Arrival of patient in Alcor OR (initial NPT 0.4°C)
	Till:	T+1	16:33	Connection of existing cannulae to OR tubing
0:27	From:	T+1	16:33	Connection of existing cannulae to OR tubing
	Till:	T+1	17:00	Completion of burr hole surgery
CRYOPROTECTANT PERFUSION AT ALCOR				
0:13	From:	T+1	16:33	Connection of existing cannulae to OR tubing
	Till:	T+1	16:46	Start of cryoprotectant ramp
0:34	From:	T+1	16:33	Connection of existing cannulae to OR tubing
	Till:	T+1	17:07	Termination of cryoprotection (no BRIX reading)
27:44	From:	T-0	13:02	Cardiac arrest and pronouncement of legal death
	Till:	T+1	16:46	Start of cryoprotectant ramp
0:30	From:	T+1	16:16	Arrival of patient in Alcor OR (initial NPT 0.4°C)
	Till:	T+1	16:46	Start of cryoprotectant ramp
0:21	From:	T+1	16:46	Start of cryoprotectant ramp
	Till:	T+1	17:07	Termination of cryoprotection (no BRIX reading)

CRYOGENIC COOLDOWN AT ALCOR				
0:49	From:	T+1	17:07	Termination of cryoprotection (no BRIX reading)
	Till:	T+1	17:56	Start of cryogenic cooldown
28:54	From:	T-0	13:02	Cardiac arrest and pronouncement of legal death
	Till:	T+1	17:56	Start of cryogenic cooldown
1:40	From:	T+1	16:16	Arrival of patient in Alcor OR (initial NPT 0.4°C)
	Till:	T+1	17:56	Start of cryogenic cooldown

12. Table of Medications Administered

T-0 days

TIME	MEDICATION	DOSE	PURPOSE
13:05 hrs	Propofol	200 mg	Anesthetic; reduces cerebral metabolic demand; reduces the theoretic possibility of increased awareness during aggressive CPS.
13:05 hrs	Heparin	50,000 IU	Anticoagulant; prevents blood clot formation.
13:05 hrs	Sodium citrate	100 mL total (1st dose 40 mL) Note 1	Anticoagulant; prevents blood clot formation.
13:06 hrs	Sodium citrate	100 mL total (2nd dose 60 mL) Note 1	Anticoagulant; prevents blood clot formation.
13:07 hrs	Vasopressin	80 IU Total (1st dose 40 IU) Note 2	Vasopressor; increases blood pressure during CPS.
13:07 hrs	Minocycline	200 mg	Antibiotic and neuroprotectant
13:08 hrs	SMT (S-methyl-isothiourea)	400 mg Note 3	Neuroprotectant (iNOS inhibitor); protects the brain from ischemic injury; raises blood pressure.
13:08 hrs	Decaglycerol/THAM	400 cc total (1st dose 60 cc) Note 4	Decaglycerol inhibits cerebral edema.
13:09 hrs	Decaglycerol/THAM	400 cc total (2nd dose 60 cc) Note 4	Decaglycerol inhibits cerebral edema.
13:09 hrs	Decaglycerol/THAM	400 cc total (3rd dose 60 cc) Note 4	Decaglycerol inhibits cerebral edema.
13:09 hrs	Antacid	240 cc total (1st dose 70 cc) Note 5	A buffer used to protect the stomach from acid erosion.
13:09 hrs	Decaglycerol/THAM	400 cc total (4th dose 20 cc) Note 4	Decaglycerol inhibits cerebral edema.

13:10 hrs	Antacid	240 cc total (2nd dose 50 cc) Note 5	A buffer used to protect the stomach from acid erosion.
13:10 hrs	Vital Oxy (w/ saline)	200 cc total (1st dose 20 cc) Note 6	Antioxidants: melatonin, vitamin E (D-alpha tocopherol), PBN (alpha Phenyl t-Butyl Nitrone) and anti-inflammatory carprofen.
13:10 hrs	Antacid	240 cc total (3rd dose 60 IU) Note 5	A buffer used to protect the stomach from acid erosion.
13:11 hrs	Vital Oxy (w/ saline)	200 cc total (2nd dose 60 cc) Note 6	Antioxidants: melatonin, vitamin E (D-alpha tocopherol), PBN (alpha Phenyl t-Butyl Nitrone) and anti-inflammatory carprofen.
13:11 hrs	Vital Oxy (w/ saline)	200 cc total (3rd dose 60 cc) Note 6	Antioxidants: melatonin, vitamin E (D-alpha tocopherol), PBN (alpha Phenyl t-Butyl Nitrone) and anti-inflammatory carprofen.
13:11 hrs	Vital Oxy (w/ saline)	200 cc total (4th dose 60 cc) Note 6	Antioxidants: melatonin, vitamin E (D-alpha tocopherol), PBN (alpha Phenyl t-Butyl Nitrone) and anti-inflammatory carprofen.
13:11 hrs	Decaglycerol/THAM	400 cc total (5th dose 20 cc) Note 4	Decaglycerol inhibits cerebral edema.
13:11 hrs	Antacid	240 cc total (4th dose 60 IU) Note 5	A buffer used to protect the stomach from acid erosion.
13:12 hrs	Decaglycerol/THAM	400 cc total (6th dose 60 cc) Note 4	Decaglycerol inhibits cerebral edema.
13:12 hrs	Decaglycerol/THAM	400 cc total (7th dose 60 cc) Note 4	Decaglycerol inhibits cerebral edema.
13:12 hrs	Decaglycerol/THAM	400 cc total (8th dose 60 cc) Note 4	Decaglycerol inhibits cerebral edema.
13:20 hrs	Vasopressin	80 IU Total (2nd dose 40 IU) Note 2	Vasopressor; increases blood pressure during CPS.
14:19 hrs	Streptokinase	250,000 IU Note 7	A thrombolytic used to break up existing blood clots.

Notes:

1. The standard formulation for sodium citrate is 20% w/v, in sterile packaging provided by the manufacturer. 10 grams of sodium citrate are given to patients who weigh less than 40 kg, and 20 grams are given to patients who weigh over 40 kg. This patient received 20 grams of sodium citrate because his weight was 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. 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.

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

6. The medications protocol dilutes 70 mL or less, based on body weight, of Vital-Oxy into 150 mL of saline for a total of 220 cc of diluted Vital-Oxy saline. Each mL of Vital-Oxy contains 194 mg Sigma Cremophor EL (or Sigma Kolliphor EL), 155 mg ethanol, 19.4 mg PBN, 3.24 mg carprofen, 1.55 mg melatonin, and 198 IU vitamin E.

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

Air transportation has been increasingly difficult with the pandemic due to limited flight options, flight delays, and operating hour restrictions at airline cargo. On T-0 days at 06:54 hrs SA was informed by the local funeral home that a major commercial airliner had four direct flights from Florida to Phoenix, every day at 04:20, 07:30, 14:11, and 16:45 (all in MST). At 09:55 hrs the funeral Director informed SA that the 04:20 flight would not be possible due to lack of staffing at the cargo department. Airline cargo requires a shipper to arrive a minimum of two hours, and recommends three hours prior to departure for cargo to be checked in. This limits early morning flights as many cargo departments do not open until 07:00 hrs. This problem is not one that Alcor can control. For the foreseeable future, airline flight problems will persist and affect the cold ischemic times experienced by patients.

The first deployment for this member was without warning, based presumably on the malfunction of a medication pump in the hospital. However, it is not explicitly clear that this was the reason for the urgent call. At the time, no one realized the pressors were leaking on the floor. Had that not happened, or if it had been noticed, Alcor may not have deployed SA at that time.

The member's Medical Power of Attorney (MPOA) wanted to pursue all avenues of recovery for the member, which can draw out deployments. The initial deployment was necessary due to the information provided by the hospital, but once the status of the member stabilized and the MPOA made it known there would be ongoing medical interventions, the MRD and Alcor's Medical Advisor were constantly re-evaluating the need to continue the standby.

Field Surgery and Washout

SA had their surgeons leave the cannulae in the patient at the end of the field washout, per their amended contract with Alcor and previous requests by Alcor. The chest was closed around the cannulae as the chest cavity did not provide enough space to tuck the cannulae inside. Then the venous cannula was connected to the arterial cannula with a U-shaped connector and the connection was topped off with perfusate to minimize air bubbles. Skin staples and sternal wire were kept to a minimum. Alcor's surgeon found that the setup with cannulae in place and connected to each other was ideal and this arrangement will be used on future cases.

Cryoprotectant Surgery and Perfusion at Alcor

This was the first whole-body case to use the new bladder-based mixing reservoir in the Alcor OR to reduce or eliminate open reservoir aerosols, and it functioned as intended.

Unfortunately, an extremely low venous return to the reservoir occurred and the lower abdomen distended rapidly as the reservoir volume decreased. The chest cavity was opened for inspection and minor leaks were noted from the arterial cannula, but nothing was visible to explain the distention.

During this time the surgeon opened the burr holes and perfusate began to flow out of the burr holes. The main pump on computer control was restarted and perfusate flowed like a fountain from both of the burr holes at a rate consistent with main arterial pump speed. This result appears consistent with previous cases featuring extended ventilator use (two weeks in this case) and 27+ hours of cold ischemic transport delay.

During cryoprotectant perfusion the large amount of flow from the burr holes indicated a lack of systemic perfusion most likely due to being on a ventilator for several days. Major brain edema was possible if perfusion was continued. The existing edematous condition of the patient was causing internal backpressure and a common side effect of continuing to perfuse is brain extrusion through the burr holes.

Cryogenic Cooldown

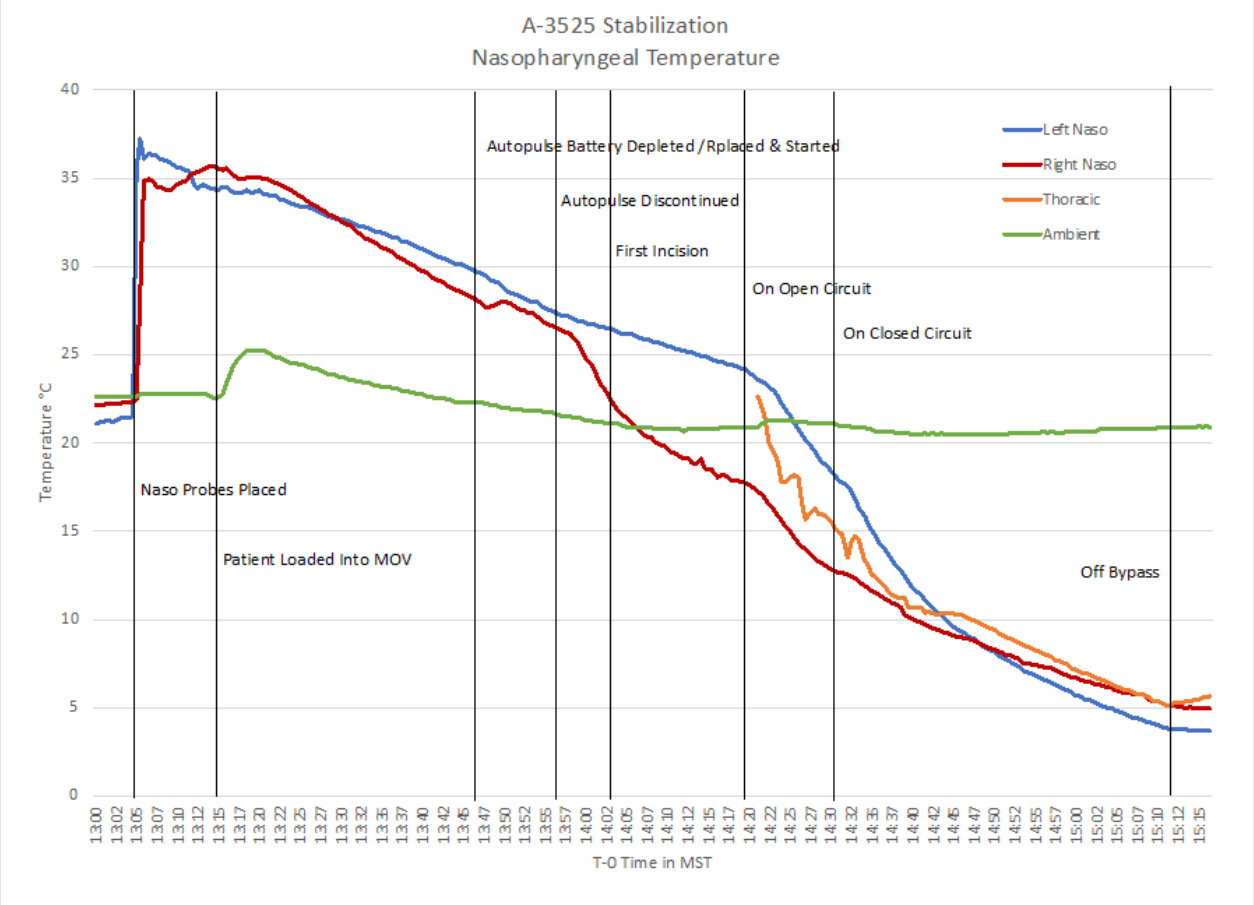
Because the cryoprotection of A-3525 was halted due to failure to perfuse, the patient was straight frozen. The standard straight freeze cooling profile has a plunge to -20°C, followed by cooling at -1C/hr. to -80°C. At -80°C, there is a pause, and the patient is transferred from the horizontal cooldown box onto a whole-body backboard and then into a solo dewar to continue the cooldown at -1°C/hr.

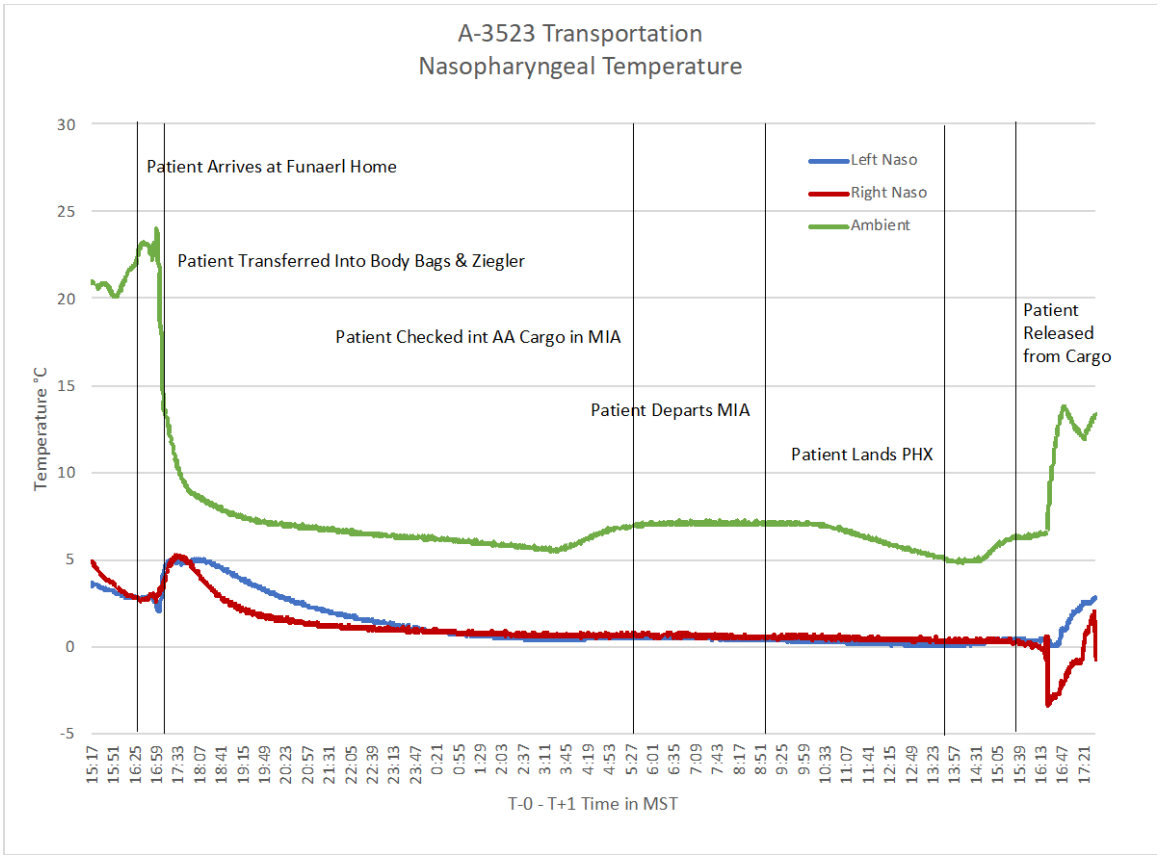
During this case, after transferring the patient into the solo dewar, a significant over-cooling of the patient was observed, despite the gas control temperature reading nominally. The team decided to open the cooldown dewar and discovered that the gas temperature thermocouple was in contact with metal at the top of the patient backboard. This caused the thermocouple to read a temperature significantly higher than the actual gas temperature, resulting in large injections of nitrogen which led to the observed cooling.

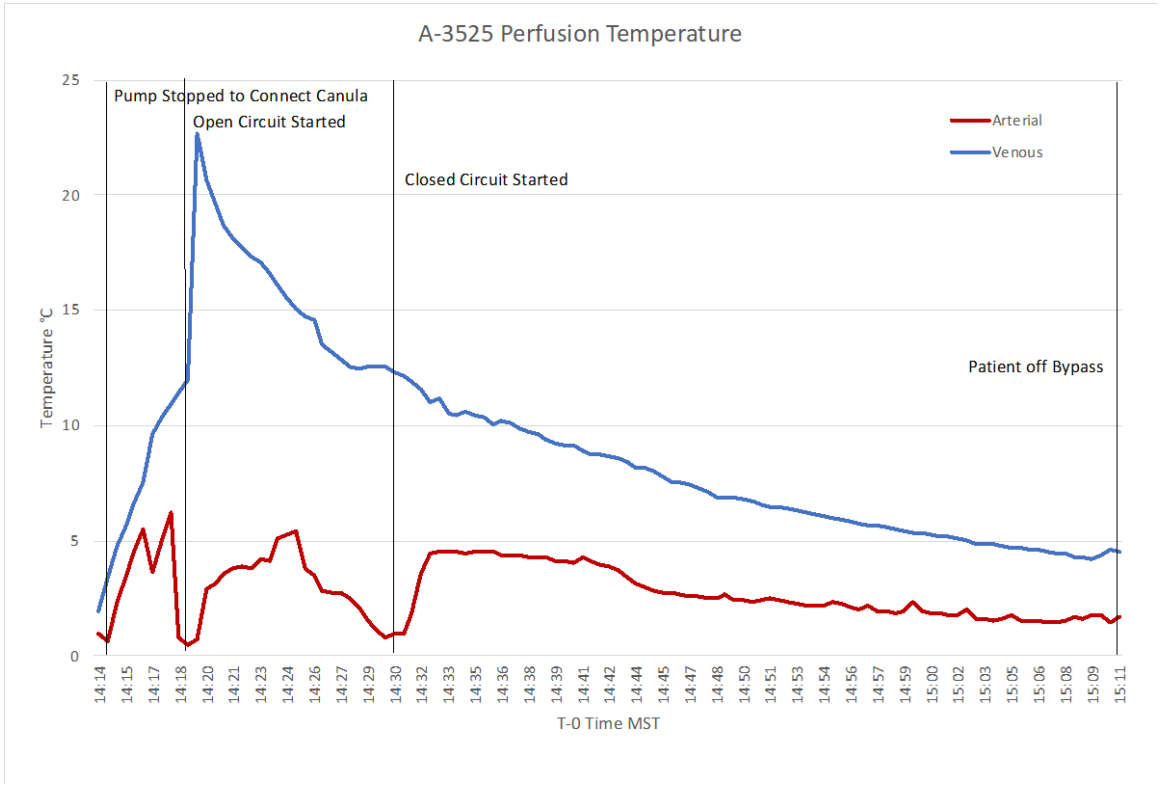
The team removed the misplaced thermocouple and affixed a new probe in a position on the lid which is guarded by a structural brace and no longer capable of contacting the dewar wall or backboard. A check of the location of the thermocouple was added to the operating procedure to prevent similar errors from occurring again. After the thermocouple was fixed, the team advanced the cooldown profile to a future point in order to avoid rewarming the patient.

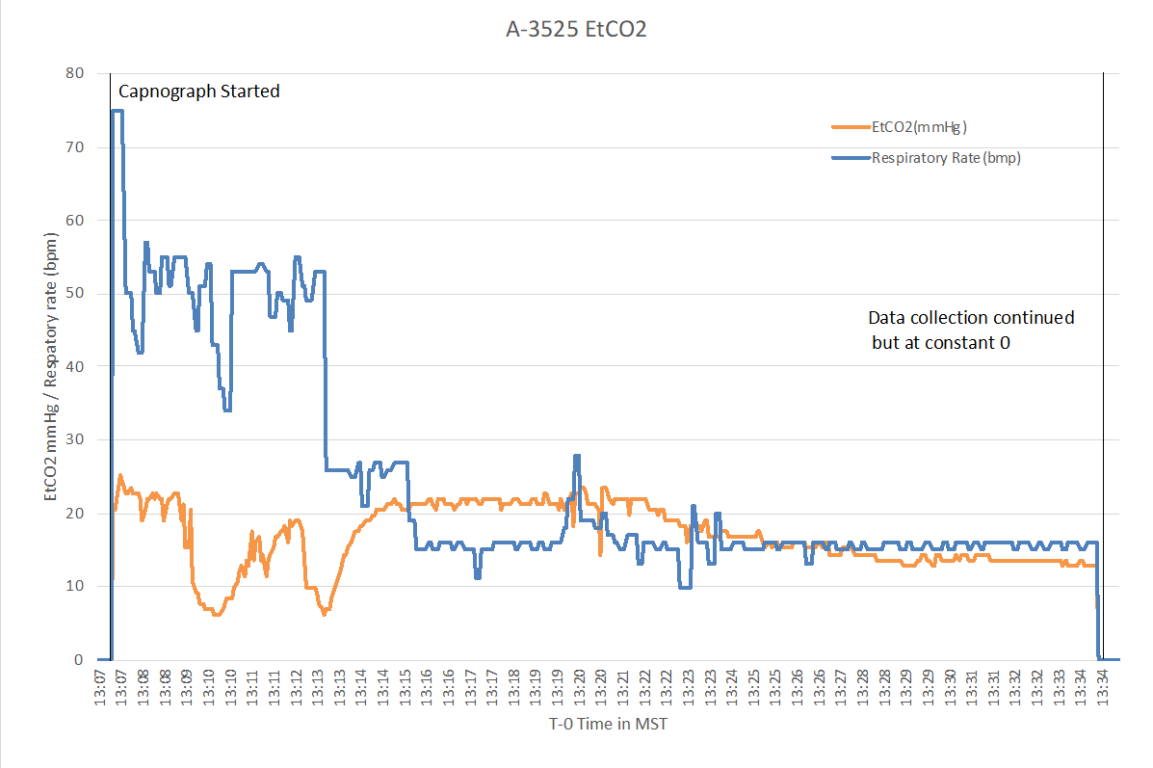
14. Cryoprotection and Temperature Graphs

Graphs by SA:

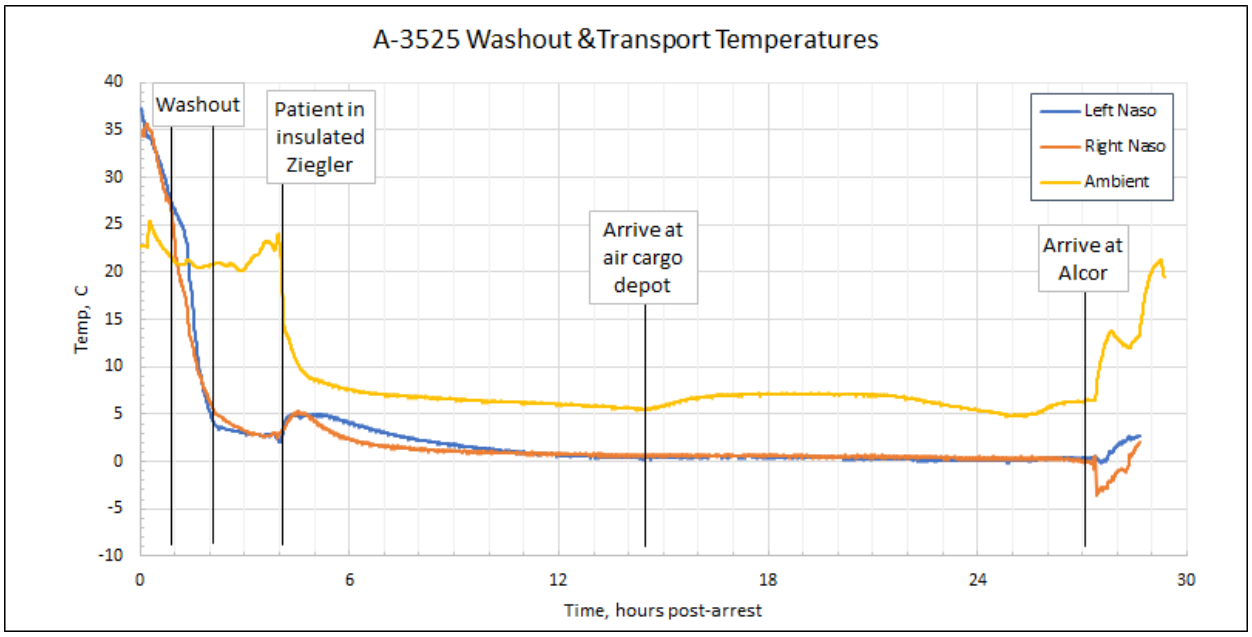


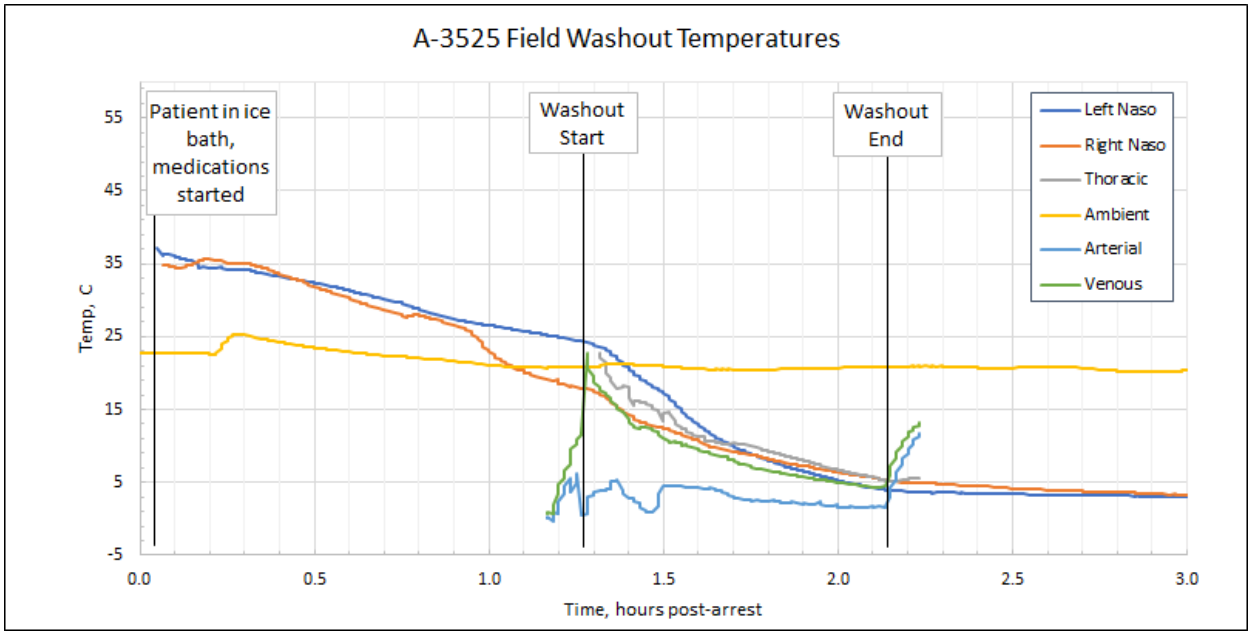

A-3523 Transportation
Nasopharyngeal Temperature
Patient Arrives at Funaerl Home
Patient Transferred Into Body Bags & Ziegler
Patient Checked int AA Cargo in MIA
Patient Departs MIA
Patient Lands PHX
Patient Released from Cargo
Left Naso
Right Naso
Ambient
Temperature °C
T-0 - T+1 Time in MST

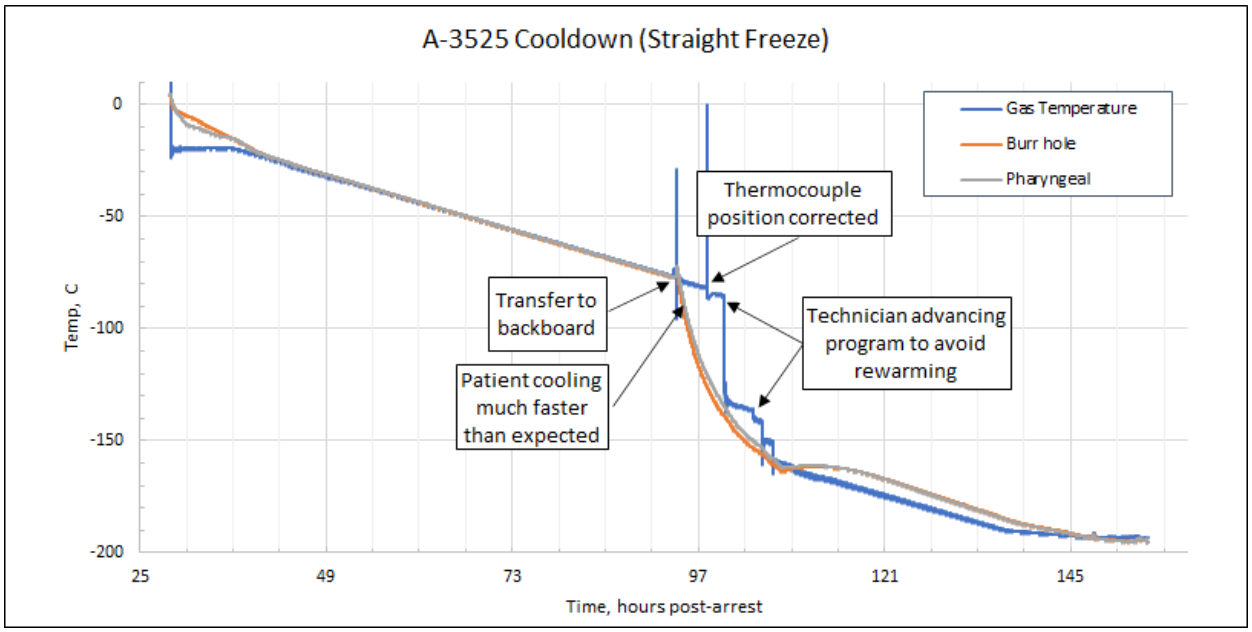

A-3525 Perfusion Temperature
Pump Stopped to Connect Canula
Open Circuit Started
Closed Circuit Started
Patient off Bypass
Arterial
Venous
Temperature °C
T-0 Time MST



Graphs by Alcor:



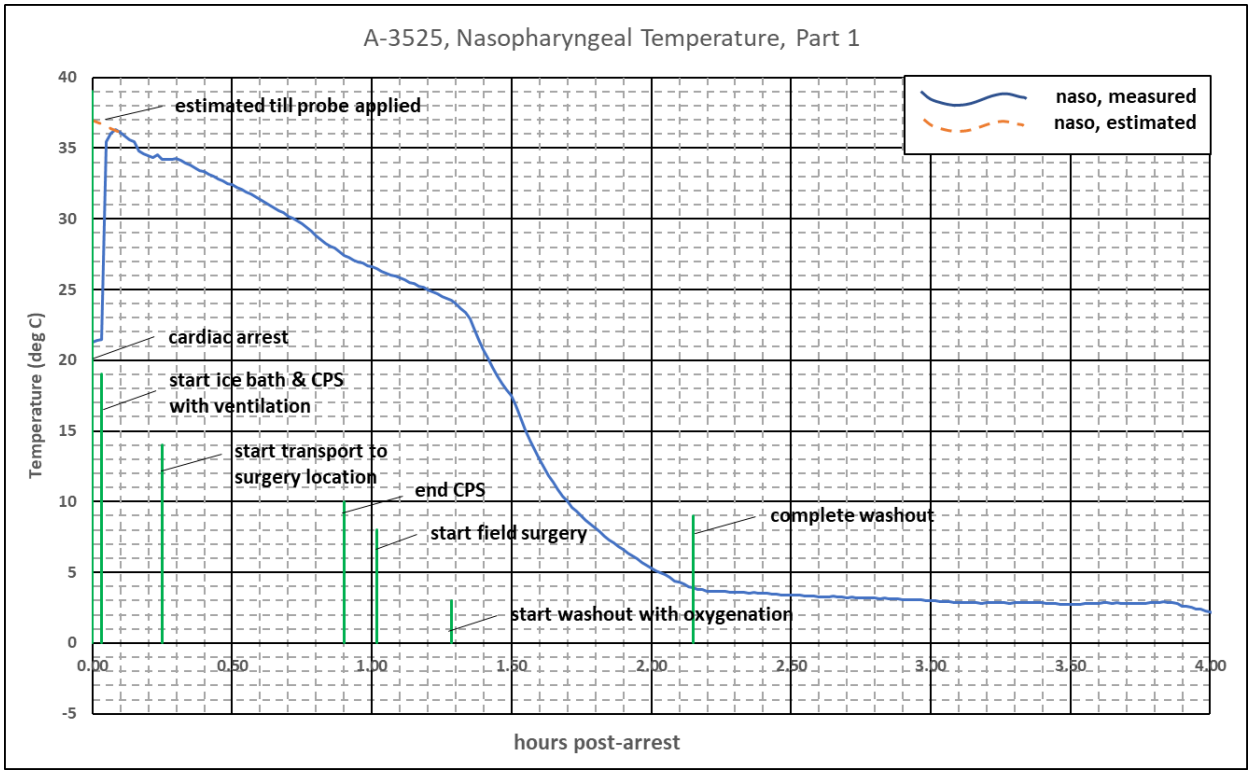

A-3525 Field Washout Temperatures
Patient in ice bath, medications started
Washout Start
Washout End
Left Naso
Right Naso
Thoracic
Ambient
Arterial
Venous
Temp, C
55
45
35
25
15
5
-5
0.0
0.5
1.0
1.5
2.0
2.5
3.0
Time, hours post-arrest


A-3525 Cooldown (Straight Freeze)
Gas Temperature
Burr hole
Pharyngeal
Thermocouple position corrected
Transfer to backboard
Technician advancing program to avoid rewarming
Patient cooling much faster than expected
Temp, C
0
-50
-100
-150
-200
25
49
73
97
121
145
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 28:54. As shown below, and due to lowering of the body temperature, S-MIX duration is shorter, at 02:48.

event	segment #	days (T+X)	time (MST) duration	post-arrest	Tnaso (deg C)	CPS w/ ventil.	washout oxygen.	S-MIX (hh:mm)
cardiac arrest		T-0	13:02	00:00	37.0			
	seg 1		00:02	00:02	-0.3	no	no	00:02
start ice bath		T-0	13:04	00:02	36.7			
	seg 2		00:00	00:00	0.0	no	no	00:00
start CPS with ventilation		T-0	13:04	00:02	36.7			
	seg 3		00:13	00:13	-2.5	yes	no	00:06
transport patient to surgery location		T-0	13:17	00:15	34.2			
	seg 4		00:39	00:39	-6.8	yes	no	00:13
end CPS (LNPT 27C)		T-0	13:56	00:54	27.4			
	seg 5		00:07	00:07	-1.0	no	no	00:03
start field surgery		T-0	14:03	01:01	26.5			
	seg 6		00:16	00:16	-2.1	no	no	00:07
start washout with oxygenation		T-0	14:19	01:17	24.4			
	seg 7		00:52	00:52	-20.4	no	yes	00:00
completed washout		T-0	15:11	02:09	4.0			
	seg 8		14:19	14:19	-3.5	no	no	01:16
patient arrives at airline cargo		T+1	05:30	16:28	0.5			
	seg 9		10:46	10:46	-0.2	no	no	00:51
patent arrives at Alcor operating room		T+1	16:16	27:14	0.3			
	seg 10		00:26	00:26	-0.1	no	no	00:02
start open-circuit perfusion		T+1	16:42	27:40	0.2			
	seg 11		00:25	00:25	1.8	no	no	00:02
end cryoprotection		T+1	17:07	28:05	2.0			
	seg 12		00:48	00:48	-1.8	no	no	00:04
start cryogenic cooldown		T+1	17:55	28:53	0.2			
	seg 13		00:01	00:01	-0.2	no	no	00:00
NPT passes through 0C (tbd)		T+1	17:56	28:54	0.0			
totals:			28:54	28:54	-37.0			02:48



16. CT Scans

Cryoprotectant Distribution (Post-cryopreservation CT scan)

Because this was a whole-body cryopreservation, no post-cryopreservation CT scans were obtained. When the in-house scanner is functional and whole-body patients are being scanned, additional information will be added to this report.