Alcor A-1604

Case Report

Prepared by:

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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-1604 was a 53-year-old member with neuro cryopreservation arrangements. Cardiac arrest was witnessed at the hospital after withdrawal of life support at 17:37 hrs on T-0 days and the member was pronounced legally deceased in Oregon at 17:37 hrs on T-0 days in 2022.

After Field Cryoprotection (FCP), the patient was air transported to Alcor for cryogenic cooldown. The patient arrived at Alcor on T+1 days at 10:00 hrs. The cooldown was initiated on T+1 days at 10:20 hrs and terminated on T+5 days at 14:50 hrs. The patient was transferred to long-term care at liquid nitrogen temperature on T+23 days at 14:02 hrs. CT scans were made of the patient's brain on T+59 days at 11:16 hrs while in liquid nitrogen.

2. Patient Assessment and Deployment

T-1 days

Alcor was notified by the medical answering service at 06:30 hrs that a member was in the emergency room (ER) for cardiac arrest and had been resuscitated. There was no information about when the patient was found, or how long the patient was in cardiac arrest before found. The estimated time of intubation and start of ventilation would be the same, as it is assumed paramedics would intubate immediately with CPR (cardiopulmonary resuscitation).

At 06:43 hrs Alcor's MRD placed a call to the hospital where the member was located and spoke to both an RN and the ER physician, and learned that the member had suffered cardiac arrest, was successfully resuscitated, and was critically stable on multiple vasopressors, and had been placed on a ventilator. The physician informed the MRD that no other information would be given due to the absence of consent from family, which they had not yet obtained.

The MRD attempted at 07:08 hrs to reach out to the family, however, all the numbers listed in the member's database were incorrect or out of service. The Deployment Committee decided at 07:14 hrs to declare a Level-1 deployment and sent International Cryomedicine Experts (ICE), one of Alcor's strategic partners for providing standby, stabilization and transport (SST) as well as field cryoprotection (FCP), while continuing to work to find a way to communicate with the member's family.

Sidebar:
The medical personnel on the Alcor Deployment Committee have determined a list of medical indicators that have either a Level-1, or 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.
The MRD called the hospital at 07:46 hrs for an update and was told that they were not comfortable giving out any information until the family was found, other than to say that they were continuing to try to stabilize the patient. Alcor's Case Logistics Manager (CLM) at 09:55 hrs arranged shipment of the Alcor field cryoprotection (FCP) kits to the member's location with

an estimated time of arrival of 16:45 hrs. The ICE team picked up the kits from airport cargo and arrived at the hospital at 17:40 hrs.

The MRD spoke to the ICE team leader at 18:40 hrs and was told that the hospital was not cooperative, not willing to give any information, and said they had documentation that would void or supersede the Alcor contract with the member. The MRD then called the hospital at 18:53 hrs and asked to speak to the house supervisor but was denied. At 19:05 hrs a social media search yielded the first new contact information for a family member. Alcor's CEO called an attorney to assist with this case.

T-0 day

Two family members called the MRD at 02:40 hrs to let Alcor know that they had been made aware of the situation and would inform the member's mother as well as ask her to call the hospital for a medical update on the member. At 03:18 hrs the member's mother called with an update. The member was still in critical condition, and on a ventilator and vasopressors.

The mother had given the hospital consent to give Alcor medical updates, however, at 08:28 hrs the MRD called the hospital to receive an update and was again denied. The member's mother was waiting for documentation that the hospital had acquired from the member on T-0 days about his end of life wishes which allegedly said he did not want to be cryopreserved.

The ICE team leader and Alcor's Case Logistics Manager went to the hospital in person at 08:54 hrs, but a medical update was refused. The hospital did confirm that the Medical Examiner (ME) had signed off on the member.

The MRD received from the member's mother at 15:03 hrs a copy of the document that the hospital claimed superseded the Alcor contract. Upon examination, the document made no mention of cryonics, cryopreservation, or Alcor. The member's mother told the hospital at 16:01 hrs that she wished to withdraw life support and allow Alcor to claim custody of the patient's remains for cryopreservation.

3. Stabilization

The member was pronounced legally deceased at 17:37 hrs by hospital staff, who then placed ice around the patient. The Alcor representative and a volunteer from Canada were in the hospital parking lot waiting for permission from the hospital to proceed. The ICE team arrived at the hospital at 17:40 hrs. The hospital staff would not allow any procedures to be done in the hospital. The patient was then transported to the funeral home, leaving at approximately 18:00 hrs and arriving at 18:35 hrs, when stabilization procedures were started.

Mechanical cardiopulmonary support was initiated at 18:44 hrs to improve external cooling and the patient's vasculature was accessed via a triple lumen cannula in the right femoral line that had been left in place by hospital staff. Administration of stabilization medications was initiated at 18:45 hrs (see the below Table of Medications Administered for the names of the medications, dosages, and times of administration). A King airway was placed at 18:47 hrs for administration of antacid to protect the stomach and ventilation of the lungs. Administration of medications was complete by 19:30 hrs.

4. Field Surgery and Cryoprotection

The bladder perfusion system and the surgical trays had been set up in advance. The nasopharyngeal temperature (NPT) was 29°C. Per protocol the team waited for the patient's temperature to drop to 20°C but were not comfortable with how long it was taking. Alcor was asked for direction on how to proceed and advised the team not to continue to wait, but to start surgery and internal cooling with the cooled perfusate as that would be more beneficial to the patient.

At 21:00 hrs cardiopulmonary support was terminated in order to start the field surgery. The right carotid artery was raised at 21:14 hrs and at 21:22 the artery was cannulated with one of the new cannulae designed and printed at Alcor (see the discussion section). Copious amounts of blood came from the oral and nasal cavities after the first incisions were made. The reason is not known, but it could have been due to anticoagulants or other medications administered to the patient in the hospital.

At 21:22 hrs 25,000 IU of streptokinase, a thrombolytic used to break up existing blood clots, was added to the first bladder to be used for cryoprotectant perfusion. The open circuit gravity-induced perfusion flow was initiated at 21:23 hrs with the first bladder of M22 perfusate (see the below Table of Concentrations (Brix) of nM22 Solution for the precalculated refractive index of the individual bladders, times when the bladders were started, and the refractive index of the effluent samples). At 21:45 hrs the left carotid artery was raised and at 21:55 hrs it was cannulated.

The height of the bladders on the teeter totter was 42 inches which is (42" x 2.054 mmHg per inch of height =) a maximum arterial pressure of 86 mmHg at the infusion site. The goal is to have the pressure between 70 and 80 mmHg and the bladders can be raised or lowered as needed to optimize flow and protection of the vasculature (see Discussion section) .

The patient's scalp was prepped at 22:00 hrs to establish the burr hole into which a thermocouple was placed to monitor brain temperature during perfusion. Using a Codman perforator and distilled water to cool the perforator bit and the skull, the burr hole was established at 22:05 hrs and secured.

Using scalpels, the tissues around the neck were separated away, leaving only the spinal column intact. The cephalon was isolated with an osteotome and mallet at 22:12 hrs and transferred to the perfusion enclosure at 22:22 hrs, after which the vertebral arteries were cannulated.

Sidebar:
Per the cryoprotection protocol, the ramp is to be paused at 30 Brix (50% of the desired terminal concentration) to allow the patient to come to osmotic equilibrium. When the bladder system is used, bladders 6 & 7 represent the pause. The cephalic 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.

With bladder #6, the 30-minute pause was initiated at 23:28 hrs. Ethylene glycol antifreeze was added to the water in the heat exchanger to allow the temperature of the perfusate to go below 0°C.

T+1 day

The open circuit cryoprotection was terminated at 02:10 hrs. The final refractive index (RI) of the effluent was 50.2 Brix. The patient was moved into the cephalic shipper and covered with approximately 10 lbs. of dry ice at 02:25 hrs.

5. Patient Transport

The ICE team and the patient left by air at 06:05 hrs.

6. Cooling to Liquid Nitrogen Temperature

The patient arrived at Alcor at 10:00 hrs still covered with dry ice. The nasopharyngeal temperature (NPT) was -7°C and the burr hole temperature was -30°C (see the Discussion section).

A computer program was used to initiate cryogenic cooldown at 10:20 hrs on T+1 days, plunging to -110°C and descending thereafter at -1°C/hour to liquid nitrogen temperature. On T+5 days at 14:50 hrs, an uneventful cooldown was terminated. On T+23 days the patient was transferred to long-term care at liquid nitrogen temperature. On T+59 days at 11:16 hrs CT scans were made of the patient's brain while at liquid nitrogen temperature.

7. Timeline and Time Summaries

Timeline

T-0	17:37	Time of cardiac arrest
T-0	17:37	Pronouncement of legal death
T-0	17:37	Ice placed around the patient by hospital staff
T-0	18:00	Start transport of patient to funeral home (time estimated)
T-0	18:35	Patient arrived at the funeral home
T-0	18:44	Start of mechanical chest compressions
T-0	18:44	Access to vasculature via line left in place at hospital
T-0	18:45	Administration of first medication (propofol)
T-0	18:47	Placement of airway
T-0	19:26	Administration of final medication (decaglycerol/THAM)
T-0	21:00	Termination of cardiopulmonary support (NPY = 29°C)
T-0	21:00	Start of field surgery
T-0	21:23	Start of open circuit cryoprotection (FCP)
T-0	22:12	Start of cephalic isolation
T-0	22:22	End of cephalic isolation (end of surgery)
T-0	23:28	Start 30-minute pause for equilibration
T+1	02:10	End of open circuit cryoprotection (FCP) (final RI = 50.2 Brix)
T+1	02:25	Start of dry ice cooling estimated)
T+1	06:05	Departure of patient from airport
T+1	10:00	Arrival of patient at Alcor (NPT = -9°C)
T+1	10:20	Start of patient cryogenic cooldown
T+5	14:50	End of cooldown
T+23	14:02	Transfer of patient to long-term care at LN2 temperature
T+59	11:16	CT scan at LN2

Time Summaries

Event Duration hr:min		days	time	
FIELD STABILIZATION				
00:00	From:	T-0	17:37	Time of cardiac arrest
	Till:	T-0	17:37	Pronouncement of legal death
00:00	From:	T-0	17:37	Time of cardiac arrest
	Till:	T-0	17:37	Ice placed around the patient by hospital staff
01:07	From:	T-0	17:37	Time of cardiac arrest
	Till:	T-0	18:44	Start of mechanical chest compressions
01:08	From:	T-0	17:37	Time of cardiac arrest
	Till:	T-0	18:45	Administration of first medication (propofol)
00:41	From:	T-0	18:45	Administration of first medication (propofol)
	Till:	T-0	19:26	Administration of final medication (decaglycerol/THAM)
FIELD SURGERY AND CRYOPROTECTION (FCP)				
03:23	From:	T-0	17:37	Time of cardiac arrest
	Till:	T-0	21:00	Start of field surgery
01:22	From:	T-0	21:00	Start of field surgery
	Till:	T-0	22:22	End of cephalic isolation (end of surgery)
03:46	From:	T-0	17:37	Time of cardiac arrest
	Till:	T-0	21:23	Start of open circuit cryoprotection (FCP)
04:47	From:	T-0	21:23	Start of open circuit cryoprotection (FCP)
	Till:	T+1	02:10	End of open circuit cryoprotection (FCP) (final RI = 50.2 Brix)
08:33	From:	T-0	17:37	Time of cardiac arrest
	Till:	T+1	02:10	End of open circuit cryoprotection (FCP) (final RI = 50.2 Brix)
01:22	From:	T-0	21:00	Start of field surgery
	Till:	T-0	22:22	End of cephalic isolation (end of surgery)
00:23	From:	T-0	21:00	Start of field surgery
	Till:	T-0	21:23	Start of open circuit cryoprotection (FCP)
05:10	From:	T-0	21:00	Start of field surgery
	Till:	T+1	02:10	End of open circuit cryoprotection (FCP) (final RI = 50.2 Brix)
DRY ICE AND LIQUID NITROGEN COOLDOWN				
00:15	From:	T+1	02:10	End of open circuit cryoprotection (FCP) (final RI = 50.2 Brix)
	Till:	T+1	02:25	Start of dry ice cooling estimated)
08:48	From:	T-0	17:37	Time of cardiac arrest
	Till:	T+1	02:25	Start of dry ice cooling estimated)
16:23	From:	T-0	17:37	Time of cardiac arrest
	Till:	T+1	10:00	Arrival of patient at Alcor (NPT = -9°C)
00:20	From:	T+1	10:00	Arrival of patient at Alcor (NPT = -9°C)
	Till:	T+1	10:20	Start of patient cryogenic cooldown

8. Table of Medications Administered

T-0 days

TIME	MEDICATION	DOSE	PURPOSE
18:45 hrs	Propofol	200 mg	Anesthetic; reduces cerebral metabolic demand; reduces the theoretic possibility of increased awareness during aggressive CPS.
18:46 hrs	SMT (S-methyl-isothiourea)	400 mg Note 1	Neuroprotectant (iNOS inhibitor); protects the brain from ischemic injury; raises blood pressure.
18:48 hrs	Heparin	50,000 IU	Anticoagulant; prevents blood clot formation.
18:49 hrs	Antacid	250 cc Note 2	A buffer used to protect the stomach from acid erosion.
18:52 hrs	Vital Oxy (w/ saline)	70 ml Note 3	Antioxidants: melatonin, vitamin E (D-alpha tocopherol), PBN (alpha Phenyl t-Butyl Nitrone) and anti-inflammatory carprofen.
18:53 hrs	Sodium citrate	20gm Note 4	Anticoagulant; prevents blood clot formation.
19:04 hrs	Decaglycerol/THAM	200 ml 1st dose Note 5	Decaglycerol inhibits cerebral edema.
19:10 hrs	Streptokinase	250,000 IU Note 6	A thrombolytic used to break up existing blood clots.
19:12 hrs	Minocycline	200 mg	Antibiotic; reduces microbial overgrowth during long transport times.
19:20 hrs	Hetastarch	250 mL Note 7	Restore volume in dehydrated patients and increase cerebral perfusion during CPS.
19:26 hrs	Decaglycerol/THAM	200 ml 2nd dose Note 5	Decaglycerol inhibits cerebral edema.
21:22 hrs	Streptokinase	25,000 IU Note 6	A thrombolytic used to break up existing blood clots.

Notes:

1. 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.

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

3. 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.

4. 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.

5. Decaglycerol/THAM is administered as a custom formulation of 20% w/v decaglycerol and 4.5% w/v THAM (tromethamine) in water (pH = 10.4 and pKa = 8.3).

6. Streptokinase is not administered with the stabilization medications but is put in the first batch of washout solution (see the Discussion section). The standard administration of streptokinase is 250,000 IU dissolved in 5 mL of 9% sodium chloride, and 25,000 IU for the abbreviated medications protocol. This medication previously needed to be infused through a 0.2 µ filter. The medication now in use is already sterile filtered and can be reconstituted in the vial.

9. Table of Concentrations (Brix) of nM22 Solution

A-1604 step-ramp, nM22									
Preferred endpoint is over 49.9 Brix from both jugulars for 1/2hr									
2L Bag label number	[nM22], CNV	Molarity of penetrating CPAs*	Brix (calc)	Bag start hh:mm, MST	hrs post pronounc-ement	Bag avg. flow rate, mL/min		Sample time hh:mm, MST	Effluent Conc., Brix
1	0.00	0.00	9.8	21:23	3.77	33.9		22:25	15
2	0.05	0.47	11.81	22:22	4.75	1000.0		22:35	22.1
3	0.08	0.78	13.14	22:24	4.78	222.2		23:25	40.5
4	0.14	1.29	15.35	22:33	4.93	166.7		23:45	42.3
5	0.23	2.15	19.03	22:45	5.13	153.8		0:00	46.9
6	0.50	4.67	29.85	22:58	5.35	153.8		0:30	47.3
7	0.50	4.67	29.85	23:11	5.57	142.9		1:00	49.4
8	1.06	9.91	52.306	23:25	5.80	133.3		1:15	50.1
9	1.06	9.91	52.306	23:40	6.05	133.3		1:27	50
10	1.06	9.91	52.306	23:55	6.30	125.0		2:04	49.9
11	1.06	9.91	52.306	0:11	6.57	117.6		2:10	50.2
12	1.06	9.91	52.306	0:28	6.85	111.1			
13	1.06	9.91	52.306	0:46	7.15	133.3			
14	1.06	9.91	52.306	1:01	7.40	117.6			
15	1.06	9.91	52.306	1:18	7.68	142.9			
16	1.06	9.91	52.306	1:32	7.92	133.3			
17	1.06	9.91	52.306	1:47	8.17	117.6			
18	1.06	9.91	52.306	2:04	8.45	333.3			
END				2:10	8.55				
* does not account for concentration of non-penetrating CPAs									

When the bladders with precalculated concentrations of cryoprotectant are made up in the lab, the first bladder in the series contains only the B1 carrier solution with no cryoprotectant and was intended to be used for purging air bubbles. Bladder #2 contains the lowest concentration of cryoprotectant. Limited experience with the bladder system, however, has shown that better edema control is provided when the initial perfusion is done with cryoprotectant. As a result, cryoprotectant perfusion is initiated with Bladder #2. When there is sufficient experience to make this the standard protocol, the lab procedure for creating the Bladders will be changed so that Bladder #1 will contain cryoprotectant.

10. Discussion

Standby and Stabilization

Per the Medications Protocol, streptokinase is not administered with the stabilization medications but is put in the first batch of washout solution. This patient (and on several other 2022 cases) was given 250,000 IU with the stabilization medications and then another 25,000 IU in the first batch of washout solution. A meeting was held with all contractors and staff to make sure a double dose is not continued. This extra medication does not hurt the patient, but it is an expensive medication and double doses are not to be given on future cases.

Due to HIPAA laws, hospitals are not as cooperative about giving medical information as they have been in the past. The MRD will write a piece for the Alcor News urging members to submit a signed and notarized document, such as the Advance Directive that Alcor provides to members, giving the hospital full permission to give Alcor medical information without verbal consent from members, family, or MPOA, essentially waiving their right under HIPAA laws.

Field Surgery and Washout

After setting up the bladder perfusion system and the surgical trays, the team waited for the patient's temperature to drop to 20°C. This was the previous protocol when surgical cannulation often took more than 30 minutes. However, because perfusion with a cooled fluid can very quickly cool the patient, it is now protocol not to wait for external cooling to bring the patient temperature to 20°C. All contractors and staff have been reminded of the protocol change.

Temperature readings tend not to be reliable during field perfusion. The Alcor staff will develop a jugular cannula similar to Alcor's new arterial cannula that can get correct body temperatures during perfusion. The Refractive Index (RI) readings were also inconsistent. In addition to designing and printing new jugular cannulae, new vertebral cannulae will be designed and printed as well.

The new arterial cannulae designed and printed at Alcor were successfully used for the first time on this case. The previous problems that had been experienced with the red Robinson cannulae (excess time required to cannulate the vessels, slipping from the vessels, and too easily collapsing) were completely eliminated).

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

This process allows for a smoother curve in the increasing concentrations of cryoprotectant. The gravity feed system for FCP uses a tripod that can be adjusted for height to control the arterial pressure. The pre-mixed cryoprotectant was in a series of bladders with graduated concentrations [measured by the refractive index (RI) in Brix units].

The height of the bladders on the teeter totter during this case was 42 inches which is (42” x 2.054 mmHg per inch of height) a maximum arterial pressure of 86 mmHg at the infusion site. The standard goal is to have the pressure between 70 and 80 mmHg and the bladders can be raised or lowered as needed to optimize flow and protection of the vasculature. On this case the pressure was over the standard goal. This has been pointed out to the contractor so that it will not be repeated in the future. The overage was not sufficient to cause damage to the patient.

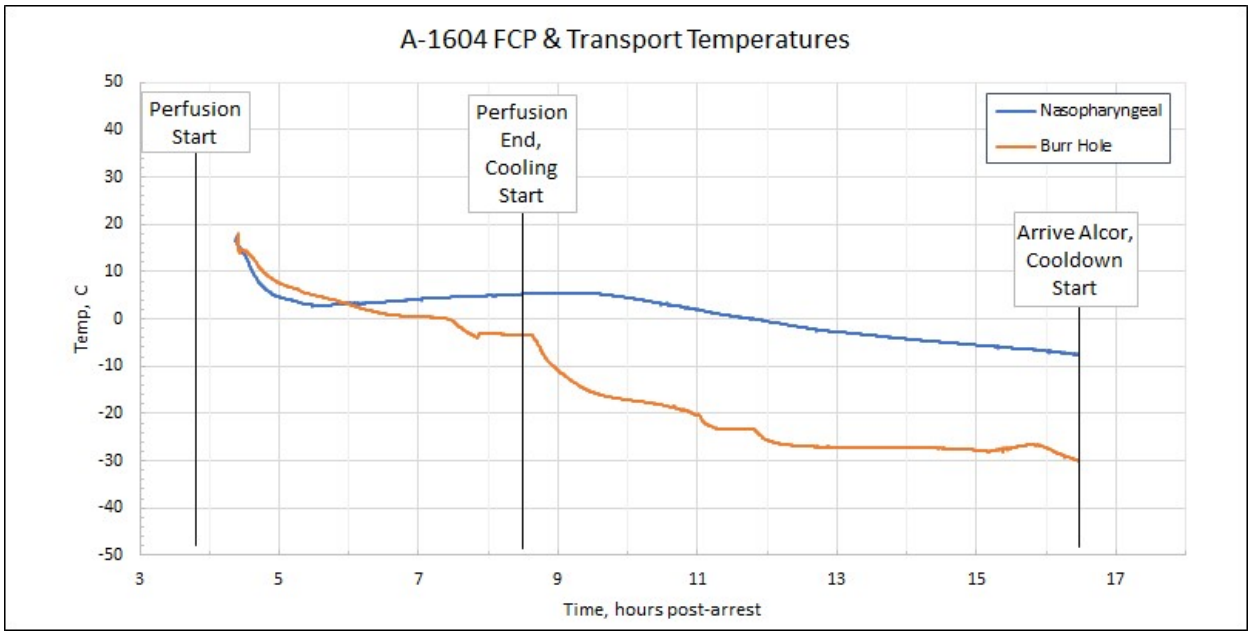
As can be seen on the Nasopharyngeal Temperature, Part 2 graph, the patient temperature rose from approximately 3°C to approximately 5.5°C. Also, it appears that after the 30-minute pause and in spite of reportedly adding anti-freeze to the water in the heat exchanger, the temperature did not drop below 0°C. The team has been instructed to pay closer attention to the patient temperature.

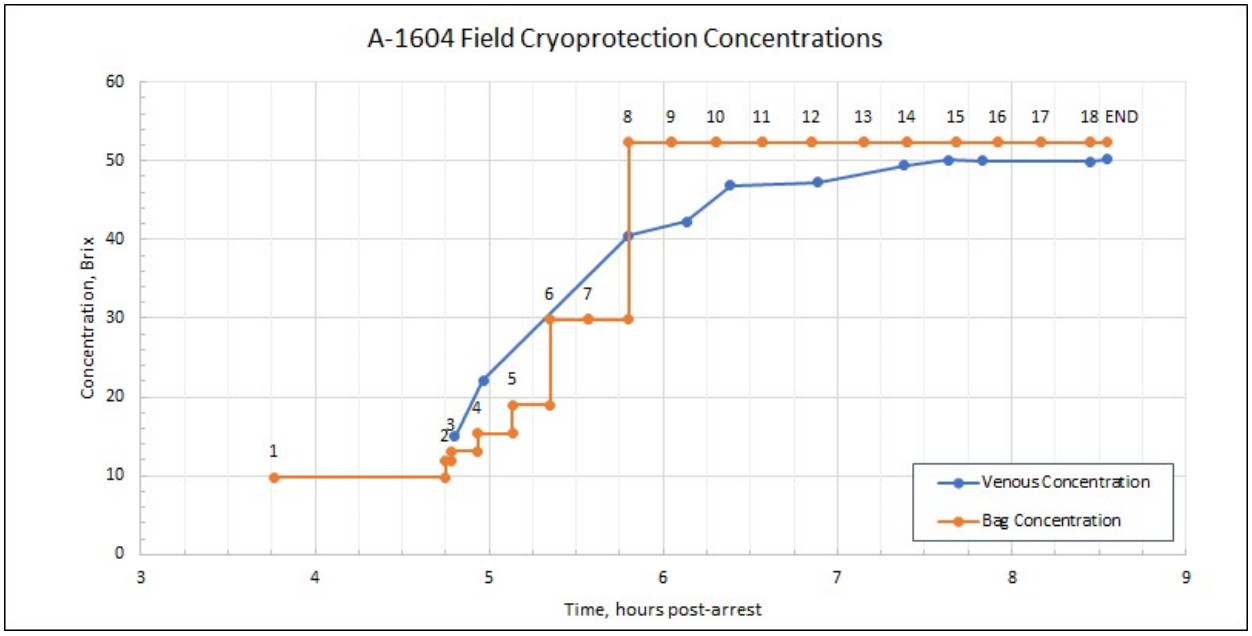
Cryogenic Cooldown

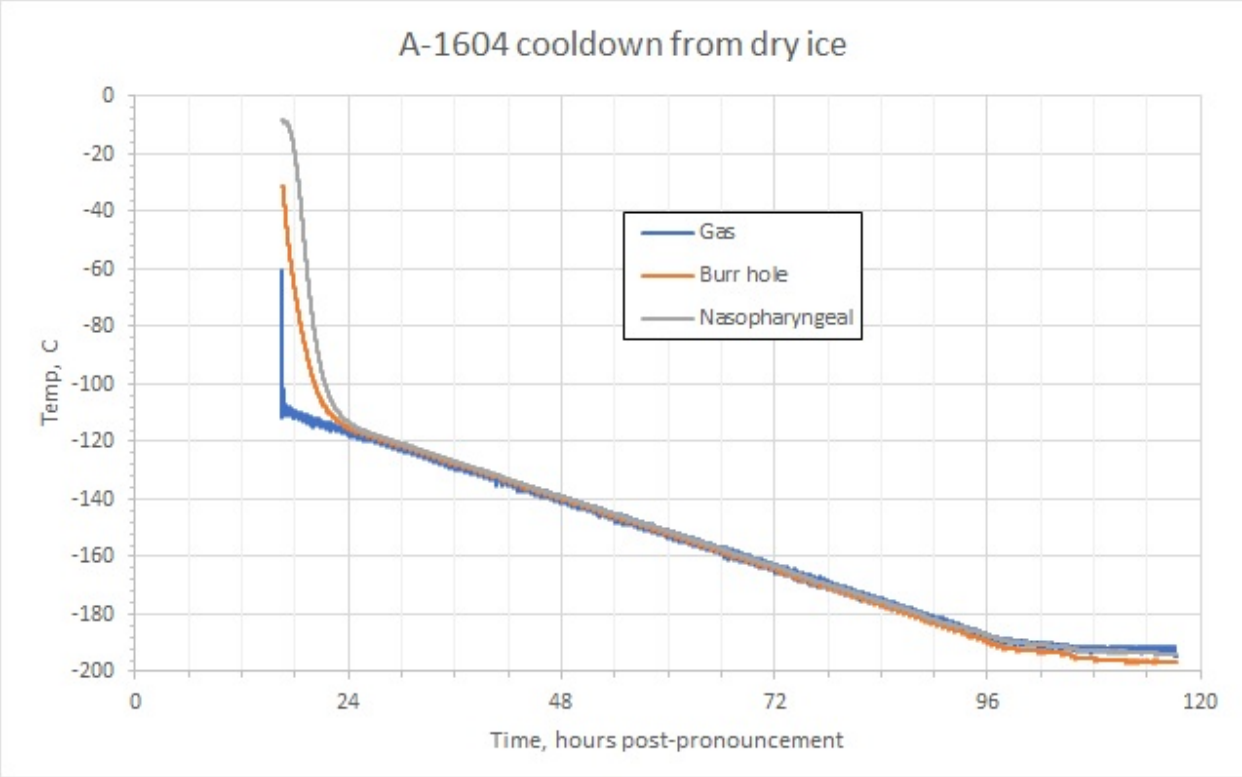
The patient was transported to Alcor rapidly after being placed on dry ice. Upon arrival at Alcor the patient’s temperatures were above dry ice temperature (NPT = -7°C, BH = -30°C). Patient temperatures drop during shipment/transport when the patient is shipped before dry ice temperature is reached, causing dry ice levels to drop during transport and a potential for the patient to warm up if there are delays. The team should always allow time for the patient to cool to dry ice temperature before starting transport. This will allow dry ice levels to drop prior to shipment/transport, so that dry ice can be replenished before transport begins.

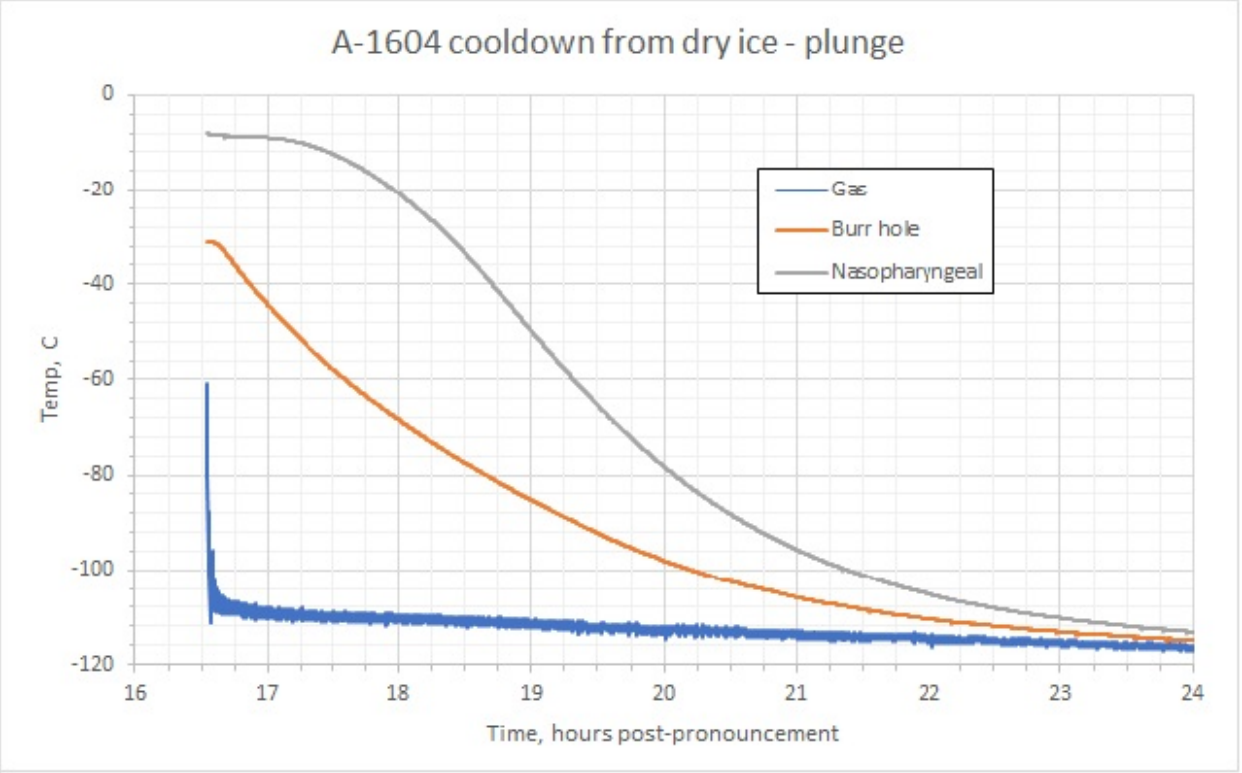
This patient did not experience rewarming during transport, but the NPT stopped dropping at about -27°C, where it remained for over four hours. The team members have been reminded of the importance of waiting until the patient reaches dry ice temperature before transporting to Alcor.

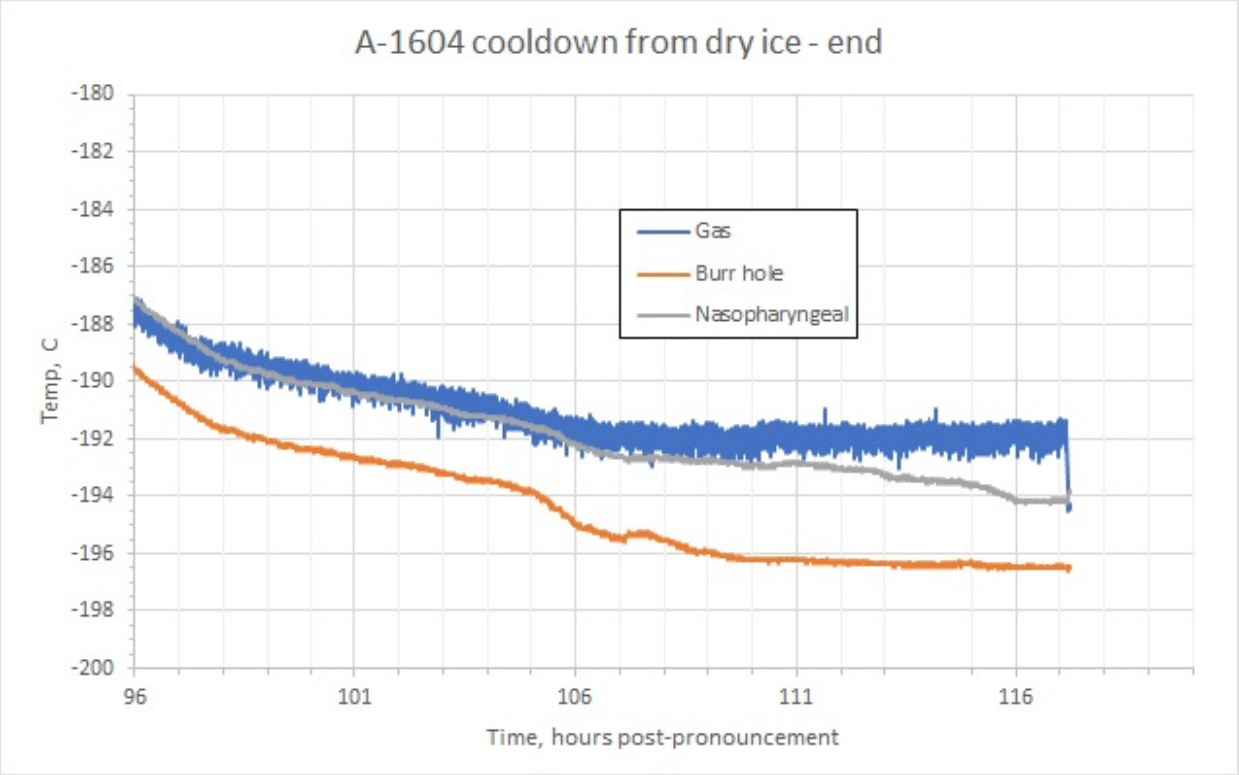
11. Cryoprotection and Temperature Graphs






A-1604 cooldown from dry ice
Temp, C
0
-20
-40
-60
-80
-100
-120
-140
-160
-180
-200
0
24
48
72
96
120
Time, hours post-pronouncement
Gas
Burr hole
Nasopharyngeal


A-1604 cooldown from dry ice - plunge
Temp, C
0
-20
-40
-60
-80
-100
-120
16
17
18
19
20
21
22
23
24
Time, hours post-pronouncement
Gas
Burr hole
Nasopharyngeal


A-1604 cooldown from dry ice - end
-180
-182
-184
-186
-188
-190
-192
-194
-196
-198
-200
Temp, C
96
101
106
111
116
Time, hours post-pronouncement
Gas
Burr hole
Nasopharyngeal

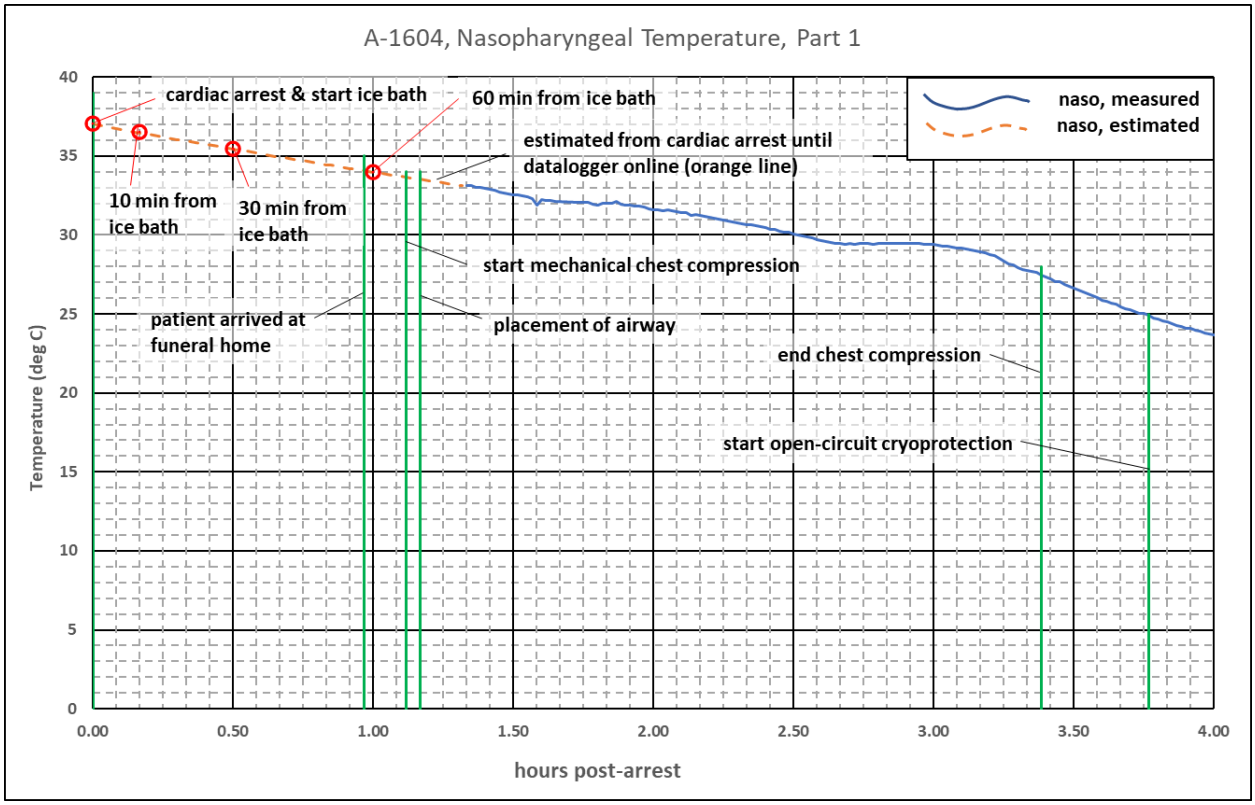
12. S-MIX

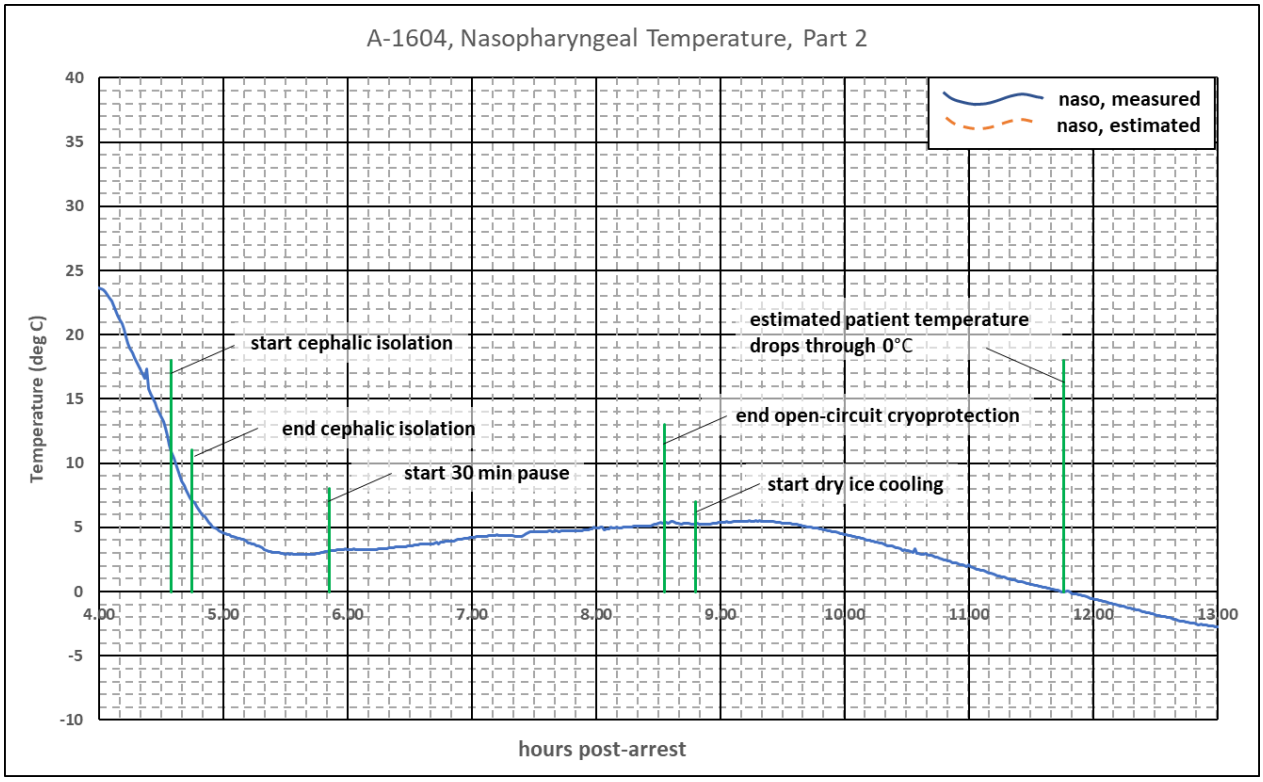
The Standardized Measure of Ischemic Exposure (S-MIX) expresses the total ischemic exposure prior to the start of cryogenic cooling as the equivalent duration of normothermic ischemia. An S-MIX of 00:00 (hh:mm) is the ideal case of no ischemic damage. The higher the S-MIX time, the more damage. Factors 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 11:46. As shown below, and due to lowering of the body temperature, S-MIX duration is shorter, at 02:56.

event	seg-ment #	days (T+X)	time (MST) duration	post-arrest	Tnaso (deg C)	CPS w/ ventil.	washout oxygen.	S-MIX (hh:mm)
Cardiac arrest & ice applied by hospital staff		T-0	17:37	00:00	37.0			
	seg 1		00:58	00:58	-2.9	no	no	00:52
Patient arrived at the funeral home		T-0	18:35	00:58	34.1			
	seg 2		00:09	00:09	-0.4	no	no	00:07
Start of mechanical chest compressions		T-0	18:44	01:07	33.7			
	seg 3		00:03	00:03	-0.1	no	no	00:02
Placement of airway		T-0	18:47	01:10	33.5			
	seg 4		02:13	02:13	-6.1	yes	no	00:44
End cardiopulmunary support & start field		T-0	21:00	03:23	27.4			
	seg 5		00:23	00:23	-2.5	no	no	00:11
Start of open circuit cryoprotection (FCP)		T-0	21:23	03:46	24.9			
	seg 6		00:49	00:49	-14.0	no	no	00:16
Start of cephalic isolation		T-0	22:12	04:35	10.9			
	seg 7		00:10	00:10	-3.8	no	no	00:01
End of cephalic isolation & end of surgery		T-0	22:22	04:45	7.1			
	seg 8		01:06	01:06	-3.9	no	no	00:07
Start 30-minute pause for equilibration		T-0	23:28	05:51	3.2			
	seg 9		02:42	02:42	2.2	no	no	00:17
End of open circuit cryoprotection (FCP) (final		T+1	02:10	08:33	5.4			
	seg 10		00:15	00:15	-0.1	no	no	00:02
Start of dry ice cooling estimated)		T+1	02:25	08:48	5.4			
	seg 11		02:58	02:58	-5.4	no	no	00:18
Patient temperature passes through 0°C		T+1	05:23	11:46	0.0			
totals:			11:46	11:46	-37.0			02:56

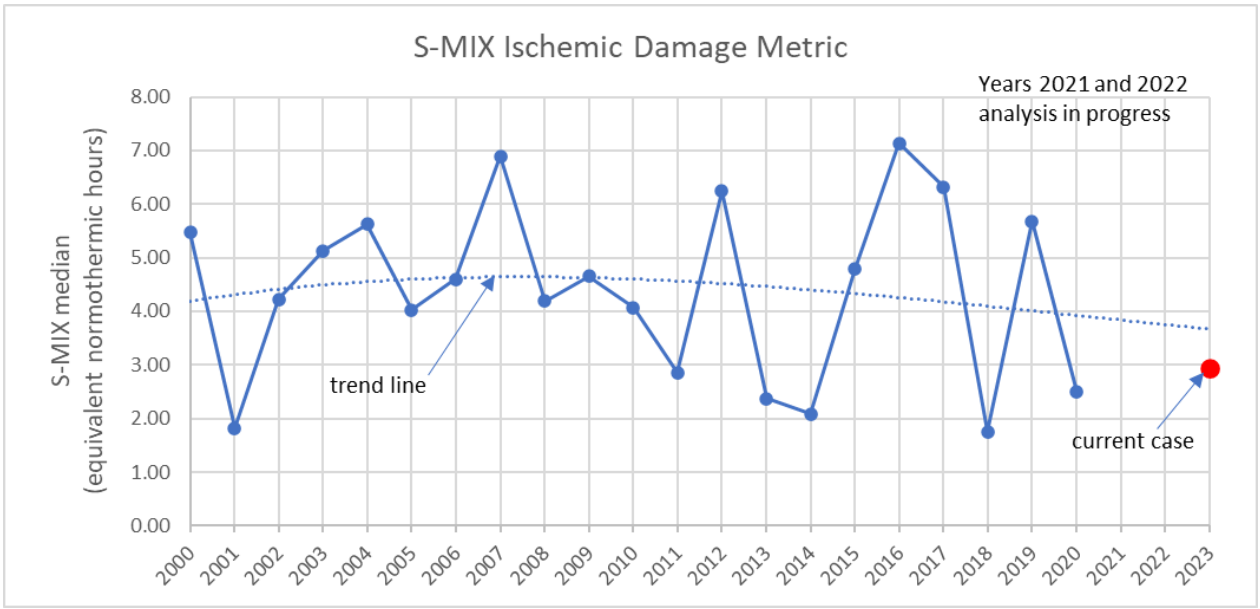
The below plots show events related to the S-MIX calculation. The red dots provide a metric for how fast the patient is cooled. This is a critical period since body temperature is highest and ischemic damage most rapid. The below table provides cooling data for 0, 10, 30, and 60 minutes after the team first applies water ice.

Patient Cooling Rate				
e: time = 0 at start of ice bath	0 min elapsed	10 min elapsed	30 min elapsed	60 min elapsed
Naso temperature (°C)	37.0	36.5	35.4	34.0
Temperature drop (°C) from t = 0	0.0	-0.5	-1.6	-3.0
Cooling rate (°C/min) from t = 0	N/A	-0.05	-0.05	-0.05



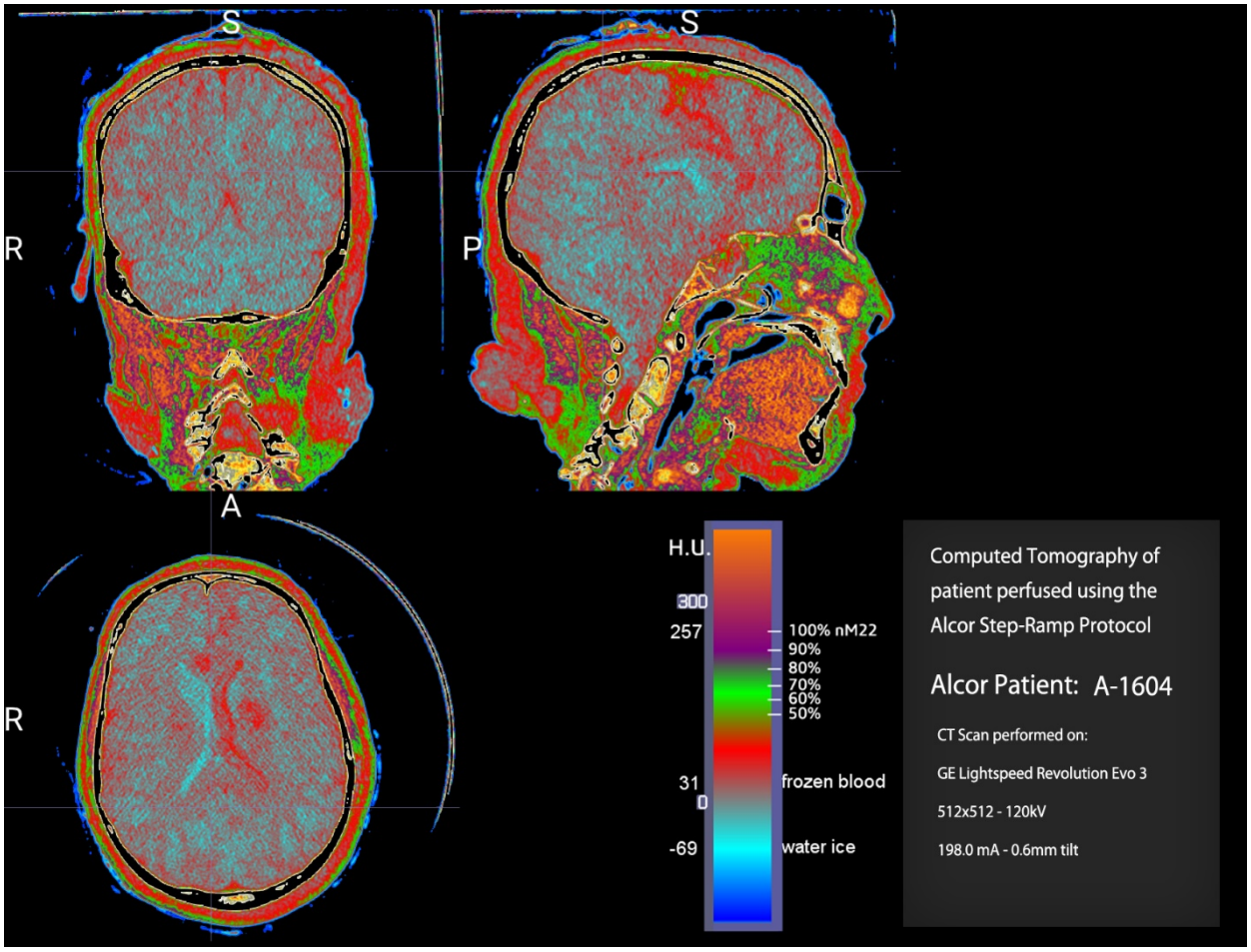


The following plot shows how the current case compares to prior years.



13. CT Scans

Cryoprotectant Distribution (Post-cryopreservation CT scan)



The post-cryogenic cooldown CT scan was obtained on T+60 days; the patient was at liquid nitrogen temperature (-196°C).

Further analyzing the CT scan imagery, it is evident that though the common carotids were successfully cannulated, and the patient underwent perfusion, minimal to no perfusate flow reached the brain through the carotid sinus or external carotid arteries. Notably, the brain did not receive cryoprotectant perfusion; however, it seems that we did perfuse the lingual and facial carotid arteries. Lack of brain perfusion is indicative of high levels of edema, consistent with the facts in this case.