Alcor A-2901

Case Report

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1. Summary

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

A-2901 was an 89-year-old member with neuro cryopreservation arrangements. A fall led to a spinal fracture and pneumonia, which led to physical decline and hospice admission. Cardiac arrest was observed at 23:40 hrs on T-0 days and the member was pronounced legally deceased in Arizona at 23:44 hrs on T-0 days in November of 2024.

After stabilization, the patient was driven to Alcor for cryoprotectant perfusion and cryogenic cooldown. The patient arrived at Alcor on T+1 days at 00:55 hrs. The cryogenic cooldown was initiated on T+1 days at 06:26 hrs and terminated on T+5 days at 12:20 hrs. The patient was transferred to long-term care at liquid nitrogen temperature on T+11 days at 14:43 hrs.

2. Member Assessment

The member had been on the Alcor Watchlist for almost two years. The member had a past medical history of frequent urinary tract infections, kidney transplants, and pneumonia. Alcor's Medical Response Director (MRD) kept in consistent communication with the member during that time.

T-25 days

The member had been hospitalized due to a fall, which resulted in a hip fracture and pneumonia. The member was now back in the assisted living facility where they resided, and vital signs were: blood pressure (BP) 110/60, heart rate (HR) 79, capillary oxygen saturation (SPO2) 96% on 3L oxygen via nasal cannula. The member, who was currently under hospice care in Florida, expressed the desire to relocate to Arizona for hospice care.

T-19 days

The Florida hospice nurse called the MRD at 12:46 hrs and reported that the member's Palliative Performance Score (PPS) had dropped to 20%, indicating transition to actively dying. The PPS showed the following declining vital signs: BP 97/55, HR 136 (irregular), RR 34 (labored), SPO2 93% on 3-4L oxygen via nasal cannula.

The PPS (Palliative Performance Scale) is a tool used in hospice and palliative care to assess a patient's functional status and progression of illness. It evaluates key areas such as ambulation, activity level, self-care ability, intake, and level of consciousness. The scale ranges from 100% (fully functional and independent) to 0% (death). Upon admission to hospice, the member was 30-40%, and this date the member was at 20%, or in other words transitioning.

3. Deployment and Standby

The Alcor Deployment Committee discussed the member's situation, and at 13:19 hrs agreed to initiate a Level-1 deployment.

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.

On Level-2 deployments, it is standard practice to ship full field cryoprotection (FCP) kits to ensure the team has what they need if unexpected cardiac arrest occurs.

T-18 days

The Alcor Deployment and Recovery Team (DART) arrived at the member's location. The member was awake, alert, answering questions with ease, and had no difficulty breathing without oxygen being administered. This was a vast difference from the reports that the hospice nurse provided the day prior.

The DART team discussed with the MRD that the member's condition the day prior was likely induced by medications being given for pain and agitation. The member's condition and behavior had led to conflicting reports, with hospice documenting a PPS of 20% while the Alcor team observed an alert and coherent individual. The deployment, though initially justified by incomplete information, was then partially recalled pending further coordination and clarification in a scheduled care plan meeting.

T-16 days

The deployment, while ultimately unnecessary, was unavoidable due to conflicting information regarding the member's condition, which was influenced by a combination of opioids and benzodiazepines. However, a clear line of communication was established with the hospice nursing staff, who were highly cooperative and understood Alcor's processes. Plans were discussed to transfer the member to Scottsdale, Arizona, for hospice care.

T-11 days

Arrangements were finalized for the member's transfer to Scottsdale, AZ, via medical transport. Availability of inpatient hospice care at a Scottsdale facility was confirmed.

T-10 days

The member arrived in Scottsdale at 18:36 hrs and was admitted into the hospice facility. The Arizona hospice facility was comfortable with the team checking the member frequently, and allowed the team to set up supplies and equipment at the member's bedside.

T-2 days

The member's condition deteriorated, with edema and mottling noted. The member's vital signs were: BP 102/60, HR 76, RR 18, SPO2 94% on 4L oxygen via nasal cannula. Decreased oral intake was observed.

T-1 days

A further decline in the member's condition was reported at 10:15 hrs when agitation, labored breathing, and decreased SPO2 was noted. The member's vitals were: BP 90/54, HR fluctuating 60 to 120 (charting at 92), SPO2 86-90% on 4L of oxygen via nasal cannula. The hospice nurse noted agitation and labored breathing. Morphine (for pain management) and Ativan (for anxiety) were being administered as needed. The vitals at 13:00 hrs were: BP 126/60, HR 94, RR 20, SPO2 90% on 4Loxygen via nasal cannula.

T-0 days

The member's condition continued to decline. The vital signs were: BP 105/60, HR 88, RR 16, SPO2 87% on 3-4L oxygen via nasal cannula. Scheduled morphine and Ativan were administered to manage agitation and pain.

At 14:26 hrs the Alcor Deployment Committee called for another Level-1 deployment. The member's vital signs at 19:27 hrs were: BP 80/36, HR 130 (irregular), RR 34 (labored), SPO2 93% on 3-4L oxygen via nasal cannula. At 21:31hrs, the vitals were: BP 62/37, HR 90 (palpated), SPO2 45% on 3-4L oxygen via nasal cannula. The fingers were cool and dusky.

4. Patient Recovery, Stabilization, and Transport

T-0 days

The DART team arrived at the hospice facility at 23:35 hrs. At 23:40 hrs the member went into cardiac arrest and was pronounced legally deceased at 23:44 hrs by a hospice nurse. The patient weight was 79.3 kg (174.4 lbs.).

The rectal occlusion device was placed at 23:47 hrs. The patient was moved into the portable ice bath (PIB) at 23:50 hrs. 200 lbs. of water ice was added. Manual chest compressions were started at 23:52 hrs to restore ventilation of the lungs with room air.

T+1 days

An EZ-IO intraosseous device was placed in the tibia of the patient's left leg to be used as a port for stabilization medications. The first stabilization medication was administered at 00:16 hrs (see the below Table of Medications Administered for the names of the medications, the dosages, and the times of administration).

Mechanical chest compression using the Amoul device was started at 00:17 hrs to circulate the stabilization medications and continue ventilation with room air. Thermocouples were placed in

the patient's nares at 00:17 hrs and 00:18 hrs. Swimmer wax was then placed around the thermocouples in the nares to prevent water from entering the area and affecting temperature readings. The initial temperature readings were: right nasopharyngeal temperature (RNPT) 35.6°C and left nasopharyngeal temperature (LNPT) 35.1°C.

Circulation of ice water around the patient (to enhance external cooling) was initiated by using the surface conduction cooling device (SCCD) inside the PIB at 00:18 hrs. The King airway was placed at 00:22 hrs to administer antacid to protect the stomach. Ventilation with an Ambu bag was started at 00:24 hrs and continued until arrival at Alcor. No automatic ventilator was available for this case (see the Discussion section).

The Arizona hospice facility was very cooperative and made an effort to get the team the transfer paperwork needed to depart the facility with the patient. The last medication was administered at 00:41 hrs just before the team and the patient left the hospice facility to relocate to Alcor.

5. Cryoprotectant Surgery and Perfusion at Alcor

T+1 days

10 liters B1 solution had been put into the mixing reservoir; perfusion would start with nM22 perfusate with 10.2 Brix concentration.

The patient, in the portable ice bath (PIB) arrived at the back door to Alcor at 00:55 hrs. The Amoul chest compression device, the surface conduction cooling device (SCCD) with face mask, and ventilation with room air were still operating. The patient was rolled into the operating room (OR) at 00:56 hrs. The initial patient temperatures on the data logger were P-1, right nasopharyngeal temperature (RNPT) 32.8°C and P-2 LNPT 33.4°C. The team waited until the patient temperature was reduced to 20°C, per protocol.

250,000 IU streptokinase added to the mixing reservoir at 01:00 hrs, to break up blood clots in the effluent from the patient once perfusion was started. The patient's temperatures at 01:12 hrs were LNPT 26.9°C and RNPT 28.3°C.

At 01:12 hrs the decision was made by the OR staff to start surgery and cold cryoprotectant perfusion as soon as possible, rather than continue to wait for the patient to reach 20°C with external cooling alone, as the patient would cool faster that way. The SCCD, the chest compression, and ventilation were all stopped in order to prepare for surgery. A Styrofoam tube was put under the patient's shoulders to lift the head out of the ice.
The first surgical cut was made at 01:21 hrs for the cephalic isolation and cannulation procedures. The left carotid artery was isolated at 01:25 hrs and the right carotid artery was isolated at 01:33 hrs. The patient temperatures at 01:37 hrs were LNPT 26.7°C and RNPT 28.5°C.

A Codman perforator bit was used to make a burr hole in the patient's left forehead at 01:44 hrs. Normal saline was poured over the drilling site to cool the bit and the patient's skull.

The cephalic isolation was completed with a mallet and an osteotome at 01:46 hrs. The pre-perfusion cephalic weight 4.595 kilograms at 01:47 hrs. The cephalon was placed in the cephalic enclosure at 01:49 hrs.

A thermocouple (T-3) was placed in burr hole at 01:52 hrs and connected to the computer data acquisition system. The initial burr hole temperature was 21.1°C at 01:53 hrs and the NPT was 26.7°C. The burr hole thermocouple slipped from the burr hole at 01:58 hrs but was not immediately replaced due to cannulation priorities.

The left carotid artery was cannulated at 02:02 hrs with an 18 French (Fr) red Robinson cannula. The right carotid artery was cannulated at approximately 02:04 hrs (time not recorded) with an 18 French (Fr) red Robinson cannula.

At 02:07 hrs, open-circuit blood substitution was started. The flow was good. The target arterial pressure was set to 70mmHg. The flow rate was 134ml/min. No flow was observed from the vertebral arteries, indicating that the Circle of Willis may not have been intact. The patient temperatures at 02:09 hrs were: BT 21.7°C and NPT 26.1°C.

The cryoprotectant ramp was started at 02:14 hrs. The ramp speed was 25ml/min. The arterial refractive index (RI) was 12.2 Brix at 02:22 hrs.

The right jugular vein was cannulated at 02:23 hrs with a standard jugular cannula. At 02:25 hrs, the vertebral arteries could not be found or cannulated. The NPT at 02:28 hrs was 14.8°C. The RI from a jugular vein sampling line (right or left not recorded) was 9.82 Brix. A new thermocouple was placed in the burr hole at 02:31 hrs to replace the one that had come loose earlier. The left jugular vein was also cannulated at 02:31 hrs with a standard jugular cannula. The pressure was increased to 80mmHg at 02:33 hrs. The flow rate was 181ml/min.

The OR electrical power went out at 02:42 hrs, possibly because of electrical work being done to install the new CT machine. The perfusion pumps and the computer had to be restarted and the computer turned back on. The power was off for no more than 30 seconds. The perfusion system was back up and running on computer control at 02:45 hrs.

The cephalic enclosure was closed at 02:47 hrs. At 03:00 hrs the tanning of the patient's face, from exposure to the vitrification solution, was noted to be progressing in a uniform manner, and the eyes were becoming concave. At 03:24 hrs, the amount of additional fluid that had been pulled from the patient due to dehydration from exposure to the vitrification solution was 200ml.

A small leak from the cannula in the left carotid artery was detected at 03:31 hrs. The main pump stopped, and the cannula was adjusted. The leak ceased and the pump was restarted at 03:32 hrs. A jugular vein sampling line was repositioned for better effluent flow at 03:35 hrs. At 03:45 hrs, the left venous RI was 30.26 Brix, and the right venous RI was 32.15 Brix. The 30-minute pause in the addition pump for equilibration was started. The cephalic enclosure temperature was lowered from +3°C to -3°C. The pause was ended at 04:15 hrs, and the pump was resumed at full speed.

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

The cephalic/patient enclosure and the chiller are switched from +3°C to -3°C operation. At the end of the 30-minute pause, the ramp is resumed at the maximum addition rate (maximum without losing total volume in the circuit) to go to 105% of the desired end concentration (49.9 Brix x 105% = 52.5 Brix) and held between 102% and 105% concentration until the terminal concentration is obtained.

At 05:25 hrs the left venous RI was 49.1 Brix, and the right venous RI was 51.4 Brix. This terminal concentration was met faster than expected. Therefore, a manual sample was taken from the right venous sampling line. It confirmed that the RI was 51.4 Brix. With the terminal concentration reached, the 30-minute countdown to end of perfusion was started at 05:45 hrs. The countdown ended at 06:15 hrs, and the cryoprotectant ramp was terminated.

The post-perfusion cephalon weighed 3.89 kg (4.595 – 3.89 = 0.64 kg loss, or a 12.5% loss) at 06:15 hrs. All lines and equipment were removed, and the patient was moved into the Patient Care Bay at 06:21 hrs. The eyebolt in the patient vertebra came out when the patient was being lowered into the LR-40cooldown Dewar. The cephalon fell approximately one foot into the Dewar and the thermocouples were dislodged. The Eye-bolt was replaced, but the thermocouples could not be replaced. If there was any damage to the cephalon, it was not something that could be assessed at that time and will need to be assessed at the time of revival.

6. Cooling to Liquid Nitrogen Temperature

Computer-controlled cryogenic cooldown was initiated at 06:26 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 12:20 hrs, an uneventful cooldown was terminated. On T+11 days at 14:43 hrs, the patient was transferred to long-term care at liquid nitrogen temperature.

7. Timeline and Time Summaries

Timeline

T-0	23:40	Time of cardiac arrest
T-0	23:44	Time of legal pronouncement
T-0	23:50	Start of ice bath cooling
T-0	23:52	Start of manual chest compressions
T+1	00:13	Placement of EZIO
T+1	00:16	Administration of 1st medication (propofol)
T+1	00:22	Placement of airway
T+1	00:24	Started ventilation with Ambu bag (room air)
T+1	00:41	Administration of last medication (decaglycerol/THAM)
T+1	00:41	Start transport of patient to Alcor
T+1	00:55	Arrival of patient at Alcor (RNPT 32.8°C, LNPT 33.4°C)
T+1	01:21	Start of surgery
T+1	02:07	Start of open-circuit washout
T+1	02:13	End of surgery and washout
T+1	02:14	Start of cryoprotectant ramp
T+1	03:45	Pause at 50% CNV
T+1	04:15	End of pause
T+1	05:45	Start 30-minute countdown to end perfusion
T+1	06:15	Termination of cryoprotectant ramp
T+1	06:26	Start cryogenic cooldown
T+5	12:20	End cooldown
T+11	14:43	Transfer to long-term care in LN2

Time Summaries

Event Duration hr:min		days	time	
00:04	From:	T-0	23:40	Time of cardiac arrest
	Till:	T-0	23:44	Time of legal pronouncement
00:10	From:	T-0	23:40	Time of cardiac arrest
	Till:	T-0	23:50	Start of ice bath cooling
00:12	From:	T-0	23:40	Time of cardiac arrest
	Till:	T-0	23:52	Start of manual chest compressions
00:36	From:	T-0	23:40	Time of cardiac arrest
	Till:	T+1	00:16	Administration of 1st medication (propofol)
00:25	From:	T+1	00:16	Administration of 1st medication (propofol)
	Till:	T+1	00:41	Administration of last medication (decaglycerol/THAM)
01:15	From:	T-0	23:40	Time of cardiac arrest
	Till:	T+1	00:55	Arrival of patient at Alcor (RNPT 32.8°C, LNPT 33.4°C)
01:41	From:	T-0	23:40	Time of cardiac arrest
	Till:	T+1	01:21	Start of surgery
00:26	From:	T+1	00:55	Arrival of patient at Alcor (RNPT 32.8°C, LNPT 33.4°C)
	Till:	T+1	01:21	Start of surgery
00:52	From:	T+1	01:21	Start of surgery
	Till:	T+1	02:13	End of surgery and washout
02:27	From:	T-0	23:40	Time of cardiac arrest
	Till:	T+1	02:07	Start of open-circuit washout
00:06	From:	T+1	02:07	Start of open-circuit washout
	Till:	T+1	02:13	End of surgery and washout
02:33	From:	T-0	23:40	Time of cardiac arrest
	Till:	T+1	02:13	End of surgery and washout
02:34	From:	T-0	23:40	Time of cardiac arrest
	Till:	T+1	02:14	Start of cryoprotectant ramp
01:19	From:	T+1	00:55	Arrival of patient at Alcor (RNPT 32.8°C, LNPT 33.4°C)
	Till:	T+1	02:14	Start of cryoprotectant ramp
00:53	From:	T+1	01:21	Start of surgery
	Till:	T+1	02:14	Start of cryoprotectant ramp
00:53	From:	T+1	01:21	Start of surgery
	Till:	T+1	02:14	Start of cryoprotectant ramp
04:01	From:	T+1	02:14	Start of cryoprotectant ramp
	Till:	T+1	06:15	Termination of cryoprotectant ramp
00:11	From:	T+1	06:15	Termination of cryoprotectant ramp
	Till:	T+1	06:26	Start cryogenic cooldown
06:46	From:	T-0	23:40	Time of cardiac arrest
	Till:	T+1	06:26	Start cryogenic cooldown
05:31	From:	T+1	00:55	Arrival of patient at Alcor (RNPT 32.8°C, LNPT 33.4°C)
	Till:	T+1	06:26	Start cryogenic cooldown

8. Table of Medications Administered

T-0 days

TIME	MEDICATION	DOSE	PURPOSE
00:16 hrs	Propofol	200 mg	Anesthetic; reduces cerebral metabolic demand; reduces the theoretical possibility of increased awareness during aggressive CPS.
00:21 hrs	Sodium citrate	20 g Note 1	Anticoagulant; prevents blood clot formation.
00:23 hrs	Heparin	50,000 IU	Anticoagulant; prevents blood clot formation.
00:24 hrs	Vasopressin (1st dose)	40 IU Note 2	Vasopressor; increases blood pressure during CPS.
00:26 hrs	Antacid	250 ml Note 3	A buffer used to neutralize stomach acid.
00:27 hrs	Minocycline	220 mg	Antibiotic and neuroprotectant
00:30 hrs	SMT (S-methyl-isothiourea)	400 mg Note 4	Neuroprotectant (iNOS inhibitor); protects the brain from ischemic injury; raises blood pressure.
00:35 hrs	Decaglycerol/THAM (1st dose)	200 ml Note 5	Decaglycerol inhibits cerebral edema.
00:36 hrs	Vasopressin (2nd dose)	40 IU Note 6	Vasopressor; increases blood pressure during CPS.
00:37 hrs	Vital Oxy (w/ saline)	40 mL Note 7	Antioxidants: melatonin, vitamin E (D-alpha tocopherol), PBN (alpha Phenyl t-Butyl Nitrone) and anti-inflammatory carprofen.
00:41 hrs	Decaglycerol/THAM (2nd dose)	200 ml Note 5	Decaglycerol inhibits cerebral edema.
1:00	Streptokinase	250,000 IU Note 8	A thrombolytic used to break up existing blood clots.

Notes:

1. The standard formulation for sodium citrate is 20% w/v, in sterile packaging provided by the manufacturer. 10 grams of sodium citrate are given to patients who weigh less than 40 kg, and 20 grams are given to patients who weigh over 40 kg. This patient weighed 79.3 kg and therefore received 20 grams of sodium citrate.

2. Vasopressin is a fixed dosage of 40 IU, per dose for two doses. The second 40 IU dose is to be administered concurrently with Vital-Oxy, I.V. Vasopressin is to be administered only if the patient's temperature is above 20°C as it is ineffective at cold temperatures.

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

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

5. Decaglycerol/THAM is administered as a custom formulation of 20% w/v decaglycerol and 4.5% w/v THAM (tromethamine) in water (pH = 10.4 and pKa = 8.3). It is a fixed dose of 400 ml to be given in two separate doses.

6. 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.

7. 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.

8. The standard administration of streptokinase is 250,000 IU fixed dose, dissolved in 5 mL of 9% sodium chloride, to be added to the blood washout solution prior to remote blood washout, or to the first cryoprotection flush in the OR. The dosage is reduced to 25,000 IU in field neuro (FCP) cases and added to the first bladder). This medication previously needed to be infused through a 0.2 µ filter. The medication now in use is already sterile-filtered and can be reconstituted in the vial.

9. Discussion

Standby, Stabilization, and Transport

The wheels on the gurney in the mobile response vehicle (MRV) did not extend once weight was added, despite testing the gurney before placing the patient on it. As this has been a problem on several recent cases, a new gurney similar to the Stryker gurney will be researched.

There was no ventilator in the van vent. All new ventilator boxes were packed in kits and there wasn't one designated to the van. For future cases, there needs to be a ventilator designated to the van. Currently, there is only one ventilator used in rotation among kits. A capital expense request has submitted to management for three additional ventilators.

Hospice personnel attempted to get the team the patient transfer paperwork as quickly as possible, but it was delayed because the human remains transport form had not been filled out in advance. This needs to be part of the team's preparation for future cases.

The team transported the patient to Alcor very quickly. The team members had been assigned tasks before the time of death and had talked through exactly what each member would do.

Communication between the DART team, the member's family, and the hospice personnel was a priority throughout the process. This resulted in a good relationship with the hospice staff and a good outcome for this case.

A manual nasopharyngeal temperature record was made 18 minutes after arrest; however the data logger was not recording until arrival at Alcor and so temperatures have been estimated to fit the known data points, as indicated in the below plot (see the S-MIX section). The DART

team has been instructed that the “record” button on the data logger must be activated immediately upon placement of the temperature probes to ensure all temperatures are accurately recorded. The MRD has inquired about changing to a data logger that does not require activation for recording, and the team has agreed that other data loggers have more issues with not being able to handle damage from freezing temperatures. The current data logger is the best option for Alcor’s needs, and the team has been instructed to avoid this operational error in the future.

Cryoprotectant Surgery and Perfusion at Alcor

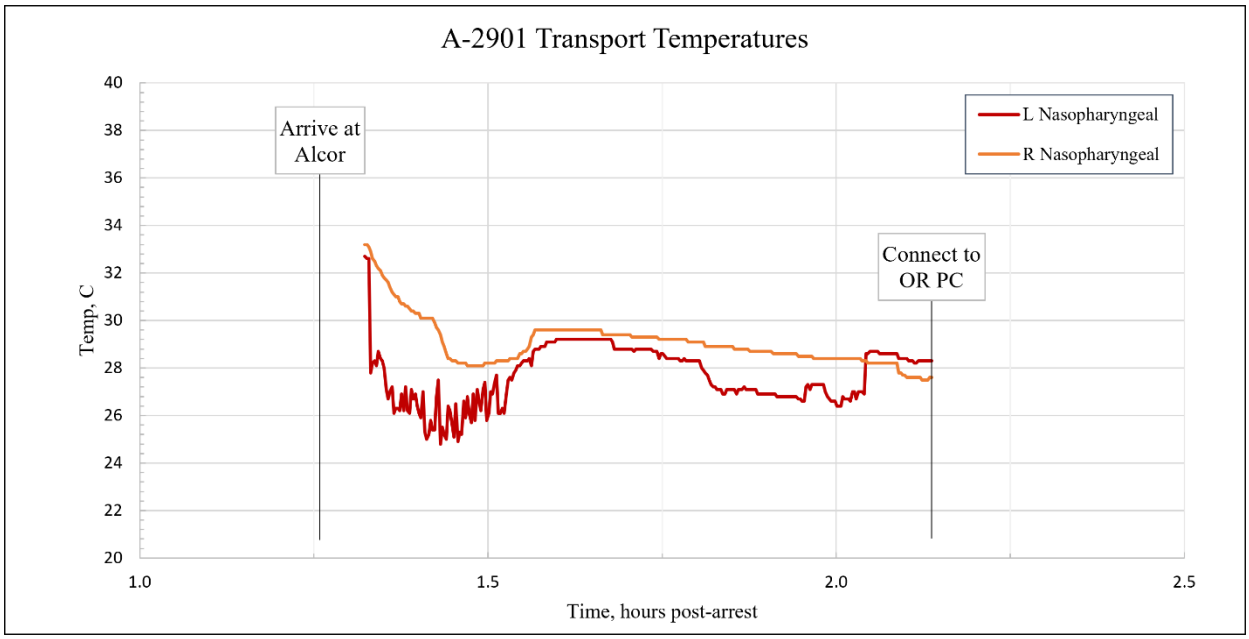
Upon connection to the perfusion system, the team observed extremely high flow rates. The team verified that all cannulas were placed properly without leaks. Flow rates continued to exceed expectations throughout the procedure. Tanning of the skin and quick temperature changes on the nasopharyngeal and burr hole probes were signs consistent with high extent of perfusion.

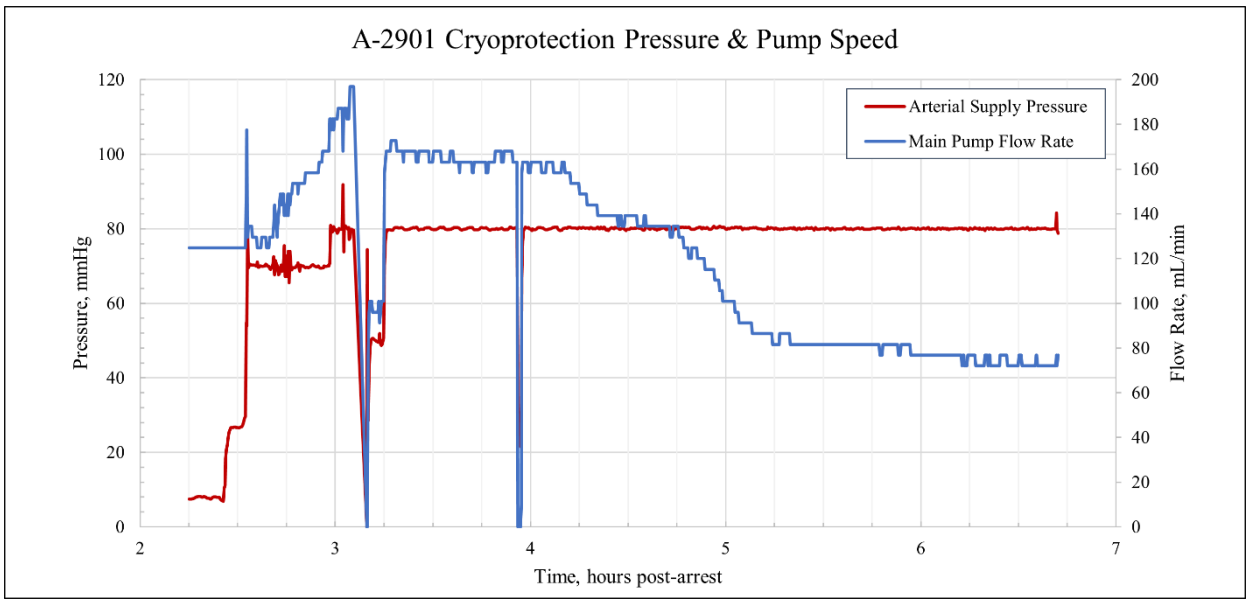
Prior to the arrival of the patient, the failure of an electrical surge protector tripped the main power breaker supplying the operating suite. The on-site generator immediately began providing backup power. During the perfusion procedure, the generator stalled for an unknown reason and power to the building failed, causing the perfusion system to shut down. The team quickly restarted the generator after determining there was no persistent cause of failure. The perfusion system was rebooted, and the procedure was successfully resumed within 4 minutes of the power outage. The main power breaker which initially tripped has been replaced.

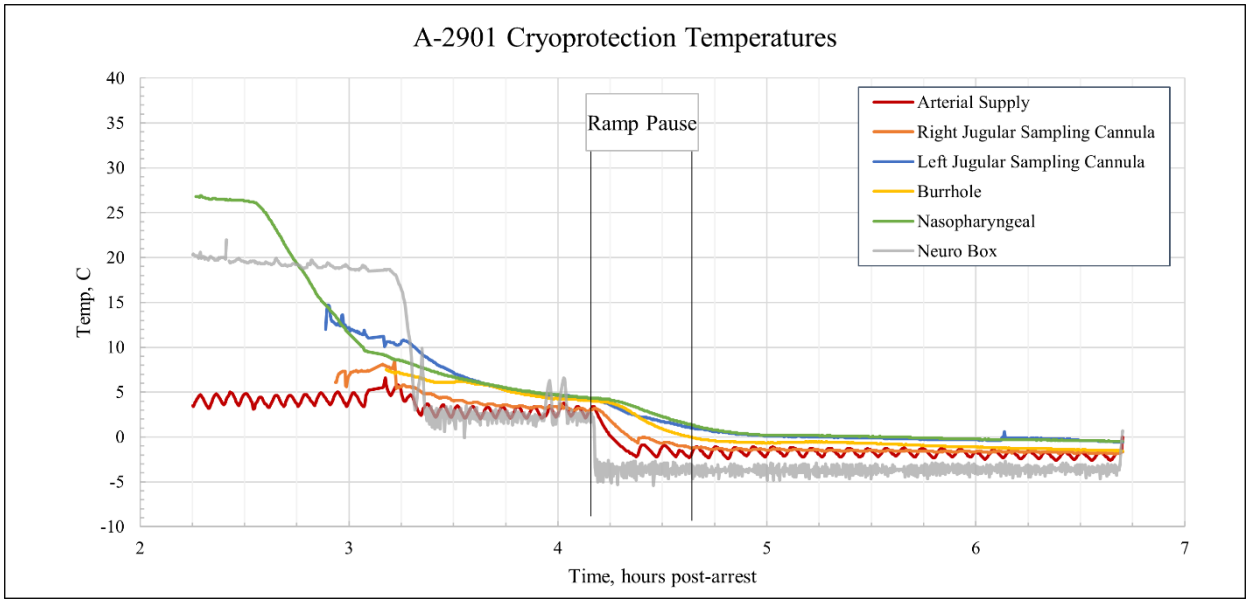
Cryogenic Cooldown

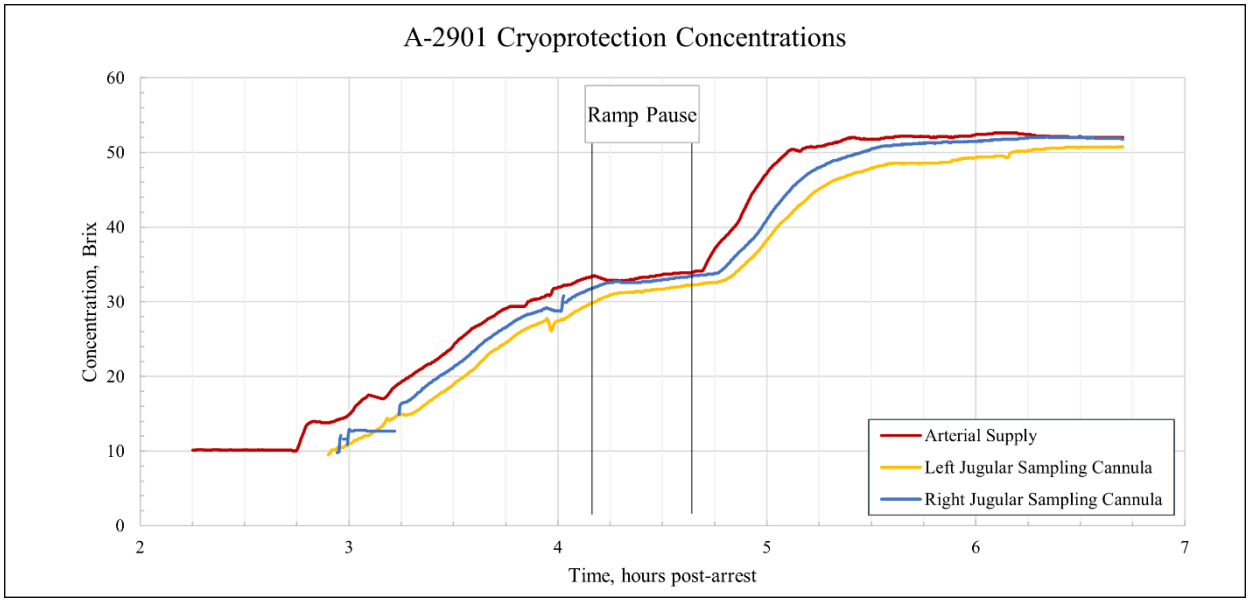
During transfer to the cooldown dewar, the lifting eyebolt placed in the spinal column became dislodged. The tissue of the spinal column was very spongy, and the threads of the bolt did not engage properly. The cephalon dropped several inches into the support tray within the cooldown dewar. Due to the routing of the temperature probes over the dewar edge, they were damaged by the lip of the dewar and disconnected from the cephalon. The team was not able to re-affix the damaged probes, and the cooldown was initiated without nasopharyngeal or burr hole temperature sensors.

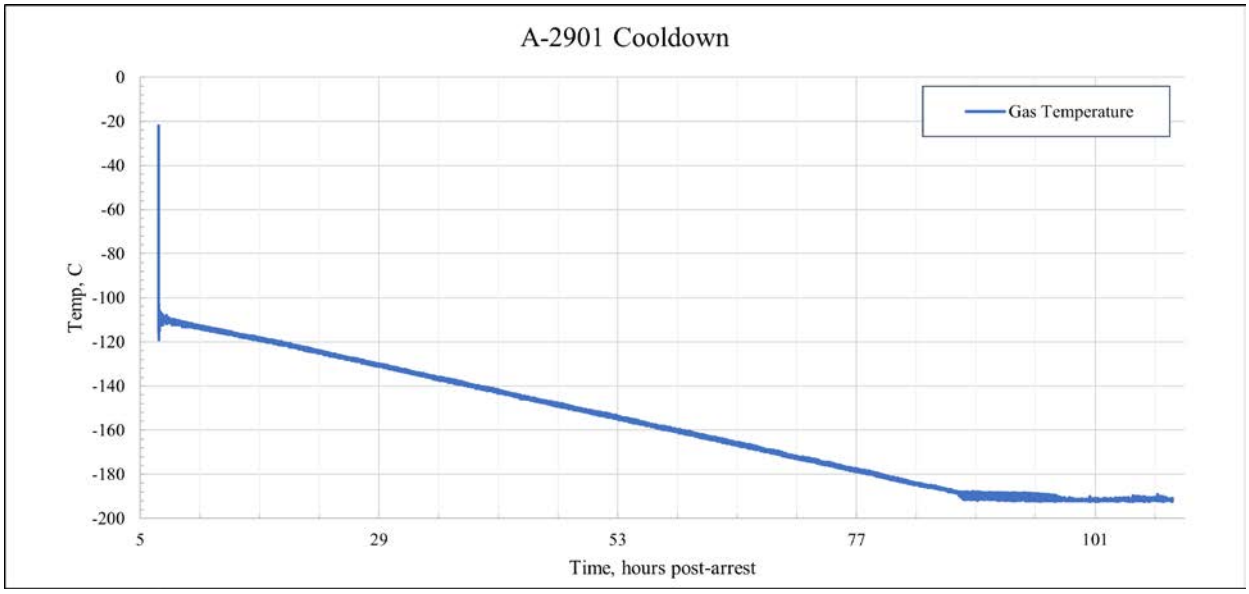
10. Cryoprotection and Temperature Graphs






A-2901 Cryoprotection Temperatures
Ramp Pause
Arterial Supply
Right Jugular Sampling Cannula
Left Jugular Sampling Cannula
Burrhole
Nasopharyngeal
Neuro Box
Temp, C
Time, hours post-arrest


A-2901 Cryoprotection Concentrations
Ramp Pause
Arterial Supply
Left Jugular Sampling Cannula
Right Jugular Sampling Cannula
Concentration, Brix
Time, hours post-arrest


A-2901 Cooldown
Gas Temperature
Temp, C
0
-20
-40
-60
-80
-100
-120
-140
-160
-180
-200
5
29
53
77
101
Time, hours post-arrest

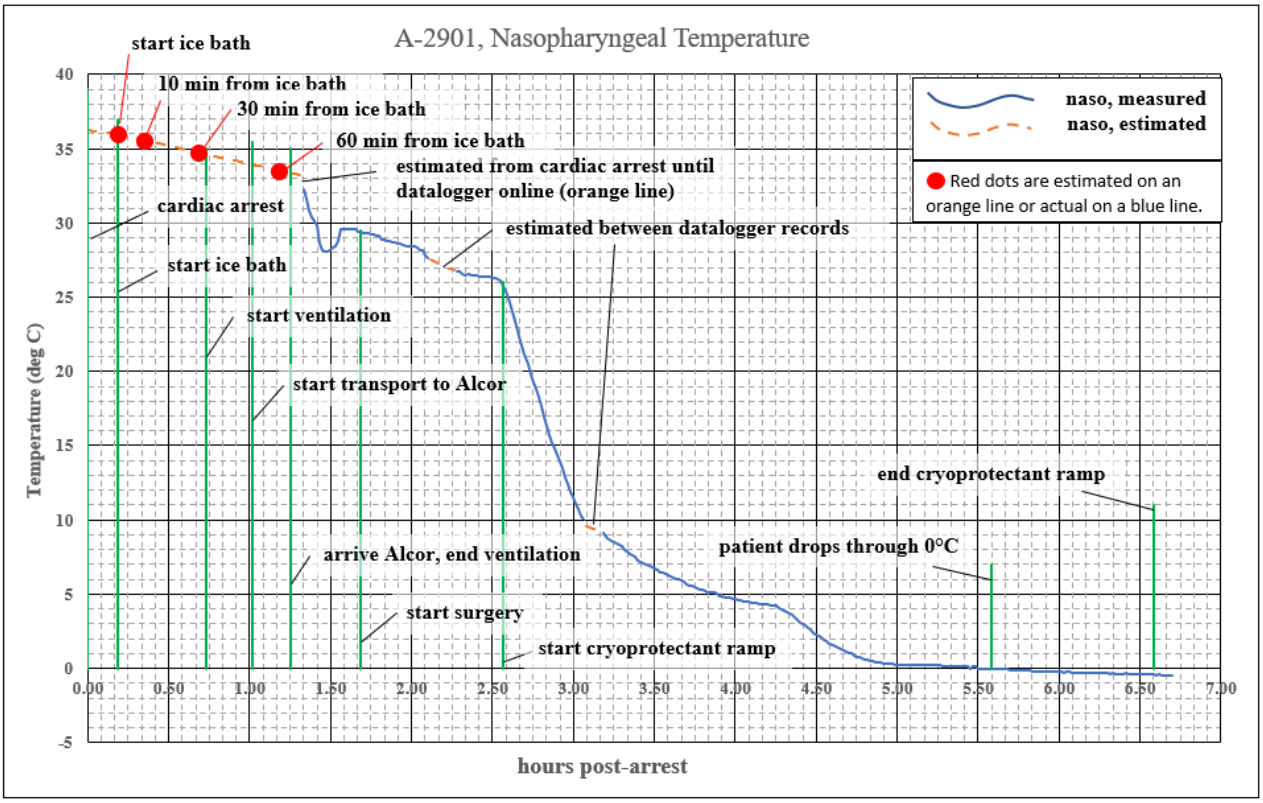
11. S-MIX and a Record of Cases Receiving Standby

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 05:35. As shown below, and due to lowering of the body temperature, S-MIX duration is shorter, at 02:00.

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	23:40	00:00	36.3			
	seg 1		00:11	00:11	-0.3	no	no	00:10
Start of ice bath cooling & chest compressions		T-0	23:51	00:11	36.0			
	seg 2		00:33	00:33	-1.4	no	no	00:29
Started ventilation with Ambu bag (room air)		T+1	00:24	00:44	34.6			
	seg 3		00:17	00:17	-0.7	yes	no	00:07
Start transport of patient to Alcor		T+1	00:41	01:01	33.9			
	seg 4		00:14	00:14	-0.6	yes	no	00:06
Arrive at Alcor and end Ambu bag ventilation		T+1	00:55	01:15	33.4			
	seg 5		00:26	00:26	-4.0	no	no	00:16
Start of surgery		T+1	01:21	01:41	29.4			
	seg 6		00:53	00:53	-3.6	no	no	00:28
Start of cryoprotectant ramp		T+1	02:14	02:34	25.8			
	seg 7		03:01	03:01	-25.8	no	no	00:23
Patient temperature thru 0°C		T+1	05:15	05:35	0.0			
totals:			05:35	05:35	-36.3			02:00

* Each case has a different level of temperature estimation. Carefully review each case before using S-MIX in analyses.

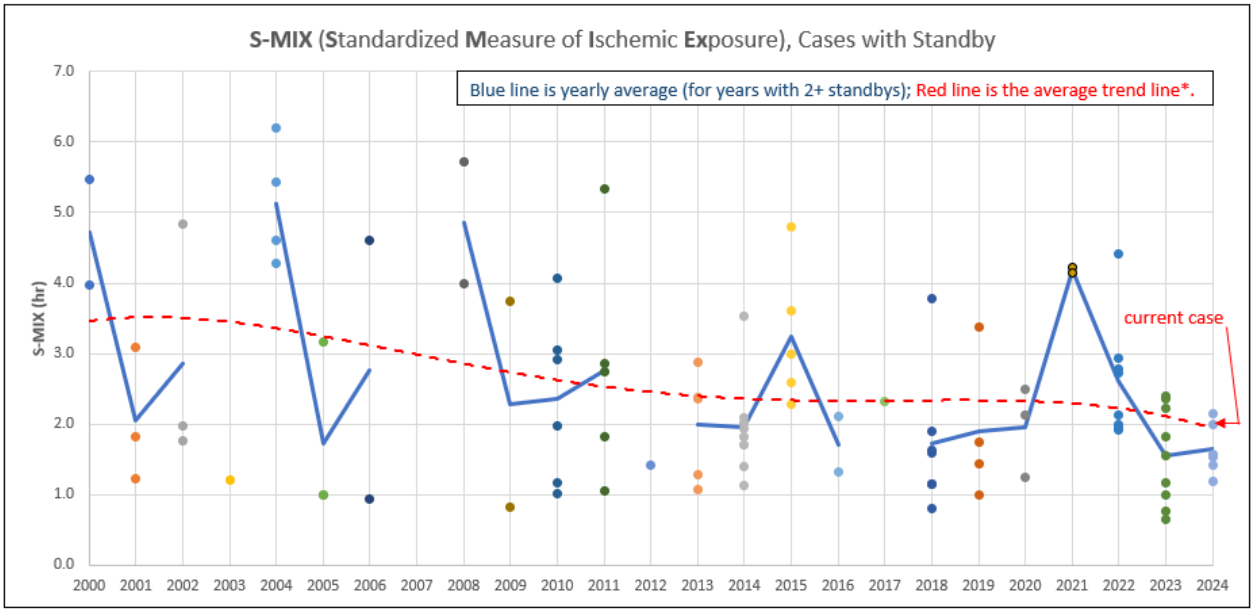
The below plot shows events related to the S-MIX calculation. A manual nasopharyngeal temperature record was made 18 minutes after arrest, however the datalogger was not recording until arrival at Alcor and so temperatures have been estimated to fit the known data points, as indicated in the below plot. The red dots can be used to construct a metric for how fast the patient is initially cooled (see the Patient Cooling Rate table below). This is a critical period since body temperature is highest and ischemic damage most rapid.



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

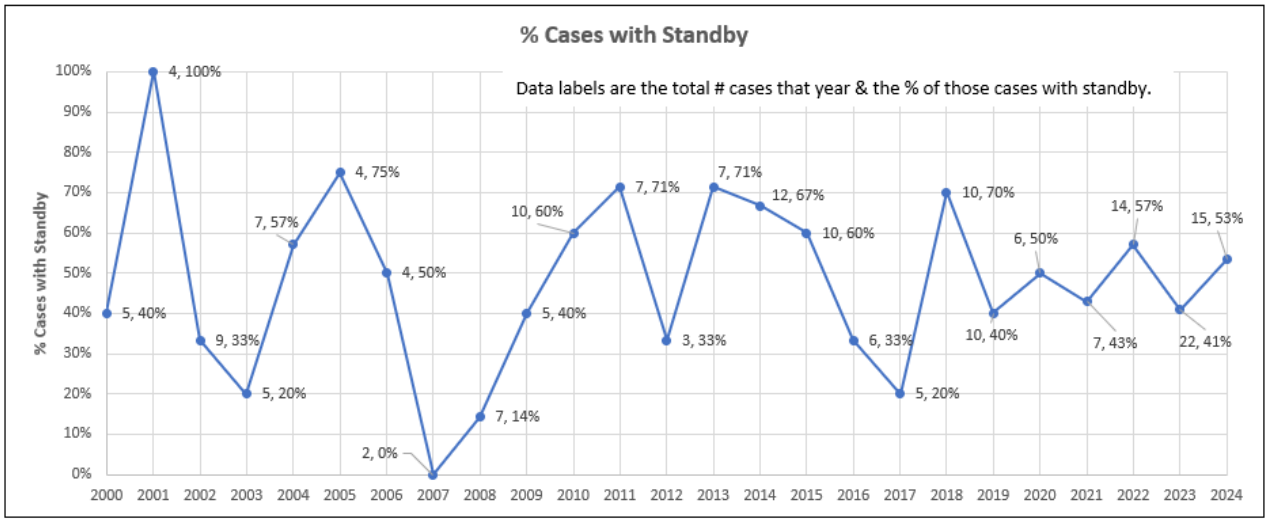
Patient Cooling Rate			(patient weight 79.3 kg; 174.4 lb)	
Note: time = 0 at start of ice bath	0 min elapsed	10 min elapsed	30 min elapsed	60 min elapsed
Naso temperature (°C)	36.0	35.6	34.8	33.5
Temperature drop (°C) from t = 0	0.0	-0.4	-1.2	-2.5
Cooling rate (°C/min) from t = 0	N/A	-0.04	-0.04	-0.04

The following plot shows the trend of S-MIX achieved since 2000 for just those cases that had standby and sufficient temperature records. Standby means that Alcor had staff and/or contractors, and their equipment, nearby the patient when cardiac arrest occurred. Each case is a dot. The blue line is the average SMIX each year. That line is broken for years that did not have at least 2 standby cases. The red line is the trend of the yearly averages. It shows a decline from 2000 to 2012, and again from 2021 to 2024, which indicates that ischemic damage is being reduced in those time frames.



* Trend line is a 4th-order polynomial fit of the blue average line.

The following plot shows how often cases receive standby. Cases may not receive standby for a number of reasons. The most common reason is that Alcor is notified post-mortem. This happens when a member dies unexpectedly, when a member dies alone, when a third party decides to cryopreserve a person after they die, and for various other reasons. Roughly speaking, half the cases receive standby. This 2024 case did receive standby.



Note: the total # cases from 2000 - 2024 is 196 and the % of those cases with standby is 50%

12. CT Scans

Cryoprotectant Distribution (Post-cryopreservation CT scan)

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