

Alcor A-2478

Case Report



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August 2012

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1. Overview

In late March of 2011, Alcor was notified that a member in Pennsylvania had entered into the hospital with severe abdominal pain and was critically ill. As her medical providers predicted that she would probably not survive, Alcor's Medical Response Director, Aaron Drake and Readiness Coordinator, Steve Graber were on a plane to the east coast within the next three hours. Upon arrival at the hospital, the member's health condition had stabilized and appeared to have somewhat improved. While the family was optimistic that a recovery might be possible, diagnostic tests and blood labs indicated that a terminal outcome was more probable. This pause in the patient's health decline provided an opportunity to request that Suspended Animation respond as well to help perform a field washout and perfusion.

On the third day of the standby, the member experienced clinical death due to an acute myocardial infarction as a consequence of ischemic colitis. Highly cooperative hospital administrators and physicians allowed the Alcor team to perform stabilization and cool down procedures within the patient's private hospital room immediately following pronouncement. The patient was then transferred to a local mortuary where Suspended Animation was set up to complete the next step in the process. The family had pre-paid additional funds to Alcor for a private jet to eliminate the potential delays associated with commercial air travel. After a six and half hour flight, the patient arrived at the Scottsdale Airport which was located just a few blocks from Alcor. The surgical team was standing by and performed vitrification procedures throughout the night.

On Saturday, March 26th, member A-2478 became Alcor's 104th patient.

2. Personnel

Standby, Stabilization and Transport: Aaron Drake, Medical Response Director; Steve Graber, Readiness/Technical Coordinator; Kelly Kingston, Standby Team Leader – Suspended Animation; and team members from Suspended Animation. They were supported by Max More, Alcor CEO; and Steve Harris, M.D., Chief Medical Advisor.

Personnel at Alcor's surgery suite included Nancy McEachern, D.V.M., Surgeon; Aaron Drake, NREMT-P, Surgical Assistant; Hugh Hixon, O.R. Director and Cryoprotection Perfusionist; Steve Graber, Assistant Cryoprotection Perfusionist; Steve Van Sickle, Cooldown; Richard Cremeens, Refractometry; Observers: Max More and Tom Wolvos, M.D.; Surgical support staff: Bruce Cohen and Jerry Searcy.

3. Pre-Deployment

A-2478 was an 83 year-old female who had recently become a member of Alcor in November of 2010, joining her two sons who were also members. She had a medical history of diabetes, congestive heart failure and coronary artery disease. At 8:31 AM (MST) on March 23rd of 2011, Alcor received a TeleMed alert informing us this member had been admitted to a hospital in Abington, Pennsylvania due to severe abdominal pains and was being prepped for emergency surgery.

Communication with the hospital confirmed the patient was critically ill and might not even survive the surgery. Within 30 minutes of the alert, the deployment committee spoke and decided to send Aaron Drake and Steve Graber to Pennsylvania. Both the family and hospital were advised that a team would arrive later that same day.

4. Deployment

By 10:40 am, the response kit had been double checked, packed and Aaron and Steve were off to Sky Harbor Airport in Phoenix. Weather on the east coast not only delayed the 12:10pm departure but also impacted the arrival time of the team in Philadelphia; finally landing around 8:30 pm (EST). After renting a vehicle, purchasing coolers and ice, and driving to the town of Abington, the team was at the patient's bedside a little after 11:00 pm that night.

The nursing manager spoke with the team and the family to discuss the developments since they had spoken earlier in the day. The patient was holding steady and her vital signs had actually improved in the last few hours. The family was encouraged by this news and wanted everything to be done to help her potentially recover from this problem. The nurse tempered their optimism by stating that the patient was still considered critical and the next few hours would potentially reveal the most likely outcome. With this news, Aaron and Steve retrieved the response kit from their vehicle in the hospital parking lot and were allowed to assemble and prepare the supplies in the room directly across from where the patient was staying.

The patient was closely monitored throughout the night and was eventually moved to the Modified Intensive Care Unit which was a much larger room and would accommodate Alcor's stabilization equipment when it was needed. To maintain close proximity, Aaron and Steve relocated the entire kit to the physician's lounge which was just a couple of doors away from the patient's new room. The patient was assigned to one specific ICU nurse who was stationed directly outside of the patient care room and could visually monitor her continuously. This extra attention allowed Aaron and Steve to get some rest in a room down the hall.

Later in the day, the patient's attending physician had analyzed her recent lab results and diagnostic imaging and claimed she was doing much better. He even went so far as to say he would not be surprised if she survived another week or possibly longer. Aaron requested copies of these results so he could share them with Dr. Harris. The hospital promised to make them available by later that evening. Max More and Dr. Harris were consulted and they discussed the change in the patient's prognosis. The initial expectation was Alcor would have to perform the stabilization with limited personnel; however now it was possible there was sufficient time to request Suspended Animation (SA) to deploy as well. Dr. Harris said he could make a much more informed decision once he had the results from patient's tests. SA was contacted and an update on the situation was provided. They discussed the possibility of a deployment once the test results were in and a better prognosis could be made.

At 11:00 pm that evening, Aaron finally received copies of the specialty consults as well as the lab reports. He called Dr. Harris and discussed the findings. Dr. Harris disagreed with the prognosis provided earlier by the patient's physician. He felt that the patient was becoming septic and she only appeared to be doing better due to the advanced measures the hospital was providing. He did not believe these measures would be sufficient to sustain her life for very long and that we should request SA immediately.

Kelly Kingston, who was the assigned team director for SA in Catherine Baldwin's absence, was contacted just after midnight on Friday, March 25th, to initiate a response. Throughout the night, deployment timelines were communicated to Aaron to keep him abreast of when the SA team might arrive. At around 7:00 am, the patient's medical providers now reversed their earlier prognosis and said they believed that the patient could potentially pass away yet the same day, due to her vital signs becoming more unstable. With this news, Aaron and Steve began to draw up the medications in preparation for stabilization.

One concern that was raised while speaking with the family, was since the weekend was quickly approaching, airline cargo would shut down Friday night and no mortuary shipments would be allowed until Monday morning. To avert this potential delay, the family offered to pay for a private jet service to transport the patient, the team and one of the son's to Alcor in Scottsdale. These plans were then coordinated between Alcor administration and the family, and a local private jet provider was contacted.

At 11:52 am, the medical staff reported to Aaron that the patient was now actively dying. Aaron and Steve moved the icebath, medications and supplies from the physician's lounge to the patient's room. Numerous doctors, nurses and administrators from the hospital had assembled both inside and outside the patient's room as word had spread that one of their patients was about to be cryopreserved. Kelly from SA called a few minutes later to report their plane had landed in Philadelphia and they would begin the process of renting a vehicle and retrieving their equipment

from the airline's cargo division. SA's perfusionist had responded from a closer part of the country and was already en route to the hospital to help with the stabilization.

Over the next 15 minutes the patient's breathing became increasing more shallow and apneic. At 12:15 pm, the attending physician listened with a stethoscope for either an apical heartbeat or lung sounds. Hearing none, he pronounced the patient. Before allowing the Alcor team to proceed however, the hospital required diagnostic verification of death through an ECG tracing. The patient was not allowed to be touched by anyone for 2 minutes while the tracing was recorded. At 12:20, the administrators confirmed they had the clinical verification they needed and granted permission for Alcor to begin.

5. Field Stabilization and Cooling

The stabilization team consisted of Aaron, Steve, the SA Perfusionist and the hospital's ICU nurse who asked permission if she could stay and help. A peripherally inserted central catheter (PICC) had previously been established by medical personnel in the patient's right femoral vein, the low volume medications of Propofol, Heparin, Streptokinase, Ketorolac, Aspirin and Gentamicin. This was then followed with a 60 ml bolus of Citrate Dextrose to flush.

The patient was rolled onto her right side and a rectal occlusion device was inserted. A portable transport sheet was tucked under her body to provide support while being moved to the ice bath. The patient was lifted off the bed and moved onto a base layer of ice in the portable ice bath. Her back was positioned directly over the Lucas 2 backboard. The top of the Lucas 2 was inserted between her arms and torso and aligned so the ACD suction cup was centered over her sternum. The battery powered unit was turned on and chest compressions/decompressions were started.

Two coolers of ice were added to the ice bath to cover her entire body except for her chest and face. A thermocouple probe was placed in the patient's nasopharynx and attached to a DuaLogR for temperature recording. The thermocouple was secured in place using a surgical stapler.

While this was occurring, Aaron called the mortuary that Alcor had contracted with and asked them to come to the hospital for a pickup. This mortuary had previously said they would allow the surgical team to perform a field washout in their prep room. While they were located an hour's drive away from the hospital, given the short amount of time to plan and that the mortuary was willing to accommodate Alcor's surgery needs, the lengthy drive would have to suffice. Aaron estimated the patient would be ready in approximately one hour and the mortuary said the driver would call when he arrived at the hospital. Meanwhile Kelly had called and left a voice

mail indicating the team had obtained a vehicle rental and were now heading over to airline cargo for the equipment pickup.

Returning to the patient stabilization, an advanced airway was established with a #4 King esophageal airway and secured using a Thomas tube holder. A ResQPod was placed in between the end of the tube and an Ambu bag valve mask prior to ventilations being initiated. The dual lumen of the airway allowed for the passage of a gastric tube so that Maalox could be administered into the patient's stomach.

A bone injection gun was used to establish an additional intraosseous access site specifically for the Baxa infusion pump to administer epinephrine and vasopressin. Once patency was verified, an initial bolus of the combined medicines was pushed to promote efficacy and then the automated pump was started.

The administration of the medium and large volume medications began. These consisted of SMT, Ni/Ky, Vital-Oxy, Hetastarch, THAM, and Mannitol. The team members would draw up the fluids in large syringes while Aaron would bolus the medications through the PICC line. This worked well as someone always had a syringe that was ready and medications could be continually pushed through the PICC line.

Kelly called again about 25 minutes into the stabilization to say that cargo had still not produced their equipment and it might be an additional 45 minutes but they would come as quickly as possible to the hospital. The mortuary was again contacted for an ETA since the team was nearing the end of their stabilization. They responded by saying they would need about another hour before they would have someone there at the hospital. Aaron reminded them about the sense of urgency that had been requested and they said they would do their best.

At around 45 minutes, the alarm on the Lucas 2 compression device sounded indicating that the battery that powered the unit was exhausted. A fresh battery was supplied and compressions resumed with only a slight delay. The power supply was switched over to AC and plugged into the wall to conserve battery power so it would be available during transport.

A crowd of medical providers and administrators outside the patient's room had watched with fascination through the sliding glass doors as the team worked through the protocols. When the last of the medications were administered, these hospital personnel came in, a few at a time, to see the ice bath up close and to ask a few questions about the process. The patient's family had previously acknowledged that it was acceptable for the hospital staff to come in and watch, provided they did not interfere or get in the way.

At 1:50 pm, the full SA team arrived at the hospital with their kit to help with any remaining stabilization. However everything was completed and they were only awaiting the arrival of the mortuary removal service. Aaron and Kelly discussed their options and decided to send the surgeon and the perfusionist to the mortuary ahead of time to begin setting up. This way, when the patient arrived at the mortuary, they could begin immediately.

Sometime around 2:15 pm, the mortuary driver called to say that he had arrived. The hospital administration had preplanned to have security escort the team and the patient to the loading dock by taking a route that utilized the service elevators rather than through the general public areas. Being a large hospital, it took around 15 minutes to traverse the hospital and arrive at the loading docks to meet the funeral home representative.

After the ice bath was loaded and secured into the interior of the transport vehicle, we departed for the mortuary. The SA team followed them in their rental vehicle while Steve and Aaron returned to the patient's room to begin deconstructing and reloading the remainder of the used kit so it would be ready for transport back to Scottsdale.

Given the distance and traffic delays, travel time to the mortuary was an hour and ten minutes, which put the team at the mortuary at 3:55 pm. The Lucas 2's battery was now exhausted and chest compressions had ceased. The average battery length is 45 minutes and compressions were estimated to have been performed for approximately three hours in total. Once inside the mortuary's garage, the ice bath was moved from the vehicle to the prep room inside where the Perfusionist and Surgeon were waiting. To aid in continued cooling, the entire ice bath was lifted onto the washout table and surgery was performed with the patient still immersed in the ice water.

6. Field Washout (as reported by Suspended Animation)

The peripherally inserted central catheter installed by the hospital during ICU care was removed and blood ooze was noted from the site. The surgeon prepped the patient's right groin for surgery by swabbing a ChloroPrep and draping the area with sterile surgical towels. A 5cm incision was made and rough dissection was used to expose the femoral vessels.

There was some damage to the region surrounding the vein due to ante mortem catheterization of the site, which made the vessel more friable than normal. Also noted near the catheter site was a clot and damage to the vessel. The dissection and cannulation was also hindered by the fact that the patient had been pronounced 4-5 hours prior to starting the procedure and had been on ice for several hours. During palpitation of the vessels a sharp, metallic, staple like thing was seen and felt. There is no explanation of what this is unless a piece of the metal stylette used to catheterize the patient had broken off.

The artery cannulation was attempted with a 21fr and the vein with a 19fr cannula. A 19fr venous and 17fr arterial cannulae were successfully used. There was some leakage in the region due to the previous venous catheter. This was addressed with additional ligatures. Light suction was applied and no drainage was noted. A slow flow forward was initiated and washout began. Approximately seven minutes into washout the patient's nasopharyngeal temperature was 7.8°C.

After approximately 23 minutes on open circuit, the circuit was closed. Then 30ml of Vital Oxy was added to the circuit during closed circulation. Perfusion was stopped at 6:47 pm. Nasopharyngeal temperature was 1.4°C. No edema was observed.

During the process of closing up the patient the venous cannula became dislodged. Additional ligatures were placed in an attempt to decrease any additional oozing/fluid loss. The intact cannula was clamped and the surgical area was closed and the patient was cleaned.

7. Transport

Aaron and Steve arrived at the mortuary near the completion of the procedure. While the surgeon was finishing, Aaron secured all of the required documents from the funeral director that were needed to transport the patient across state lines. The private jet company was contacted and notified of the pending departure and expected arrival time at the airport. They said they would have their pilots ready to depart when we arrived.

The patient was then placed into two body bags that were supplied by the mortuary. The inner body bag contained the patient while the outer body bag contained roughly 90 lbs of ice bags. This double bagging system was suggested as the durability of the body bags appeared to be of a medium grade. These bags were then loaded into the back of the mortuary transport vehicle. The SA team split up at this point, some to stay back and clean while others continued to the airport to help load the body bag and return the rental vehicle. The time was now 7:43 pm.

After stopping along the way for fuel and additional ice, the team arrived at the airport at 8:20 pm. Loading the body bag onto the private jet proved to be challenging due to the sharp angle of the jet's door with respect to the main cabin area. After securing the body bag to the interior couch, the jet departed at 8:44 pm, stopping once for fuel in Illinois.

During the flight, we noticed some of the water ice that was contained between the two body bags had leaked out on to the floor. To prevent any additional leaking, we opened up the outer bag and scattered a container of Terasorb hydrogel into the ice which would convert any remaining moisture into gel. This worked well and no additional leaking was found. Without any further problems, the jet arrived in Scottsdale at 3:20 am, Saturday, March 26th (12:20 am MST) after 6.5 hours of flight time.

Upon arrival at the airport in Scottsdale, we experienced the same difficulty in off-loading the body bags as we did while loading - the bend was very difficult to negotiate. Eventually, the bags of ice were removed from the outer body bag to increase the flexibility and we were finally able to off-load the patient to the contracted mortuary's delivery vehicle. After a short drive, we arrived at Alcor's surgery bay at 12:53 am.

8. Surgery

The patient was moved onto the surgical table and was recovered with fresh ice bags. Steve shaved the patient's head and Aaron aseptically prepped the region to be incised. Dr. Nancy McEachern made two vertical incisions with a scalpel to expose the skull. She parted the scalp incisions with two Weitlanders. Bruce Cohen created two burr holes using a Codman craniotome perforator. The exposed dura mater of the brain was cut through using a #10 blade scalpel and the remainder was cleaned with a Kerrison rangeur. A thermocouple probe was inserted into the right burr hole and secured to the scalp with a surgical stapler.

Meanwhile, Aaron had aseptically prepped the region to be incised on the patient's chest. The chest was draped with sterile towels and secured with Backhaus towel clamps, leaving only the sternum exposed. Dr. McEachern then proceeded to make a vertical inline incision with a #10 blade scalpel along the sternum. Aaron placed the edge of the sternal saw blade above the sternal notch. He guided the saw distally through the patient's sternum. After the sternum separation was completed, the chest was opened with Fianchetto spreaders and the pericardial sac was exposed. Access to the heart was accomplished by cutting through the pericardium.

Dr. McEachern performed an arterial cannulation of the heart by sewing a purse-string suture into the wall of the aortic arch, puncturing the vessel within the purse-string, and advancing and securing the catheter. She then repeated this process for venous cannulation of the heart.

After securing both the arterial and venous cannulas, they were attached to the perfusion circuit. The extracorporeal perfusion circuit had been primed with B1 base perfusate solution prior to the surgery which was being circulated through the bypass loop. When cannulation was complete, the circulation was transferred from the bypass loop to the cannulas. The circuit was switched from closed circulation to open circulation and any residual blood and perfusate was washed out of the patient's vascular system over the next 10 minutes. After the washout was completed, the circuit was closed and the ramp was started.

Although not a part of the main surgery, the patient began losing volume due to the femoral surgical wound from the earlier field washout. Although Dr. McEachern had left for the night,

she was called back to address the leak. She sealed up the wound with suture until the leak was reduced to a minimum.

The following is a cryoprotection summary by Hugh Hixon:

- By the numbers, this looked pretty good. We were able to get to terminal concentration in the venous return for over 30 minutes.
- Changes in the pharyngeal temperature indicate that there was at least some circulation to the brain.
- There was no sign of a phase transition in the cooldown curve, nor any cracking events. Combining this with the pharyngeal temperature data, I'm inclined to think we did reasonably well however the brain did not retract. But it also did not extrude significantly into the burr hole.
- The eyes did not shrink, and the eyelids swelled a lot (they were somewhat swollen on arrival). The scalp swelled, as did the rest of the face.
- The right leg was not perfused, as its femoral vessels were used for the washout. The left leg was very dehydrated, and the arms less so. Except for the limbs, there was very little skin mottling so the body's skin was poorly perfused.
- The abdomen was tense with perfusate; there is some question of intestinal necrosis as a cause of the patient's final hospitalization.
- The wound for the fem-fem bypass extended past the femoral crease and through the abdominal wall. There was substantial leakage through this hole from the abdomen until the surgeon sutured it shut. This may have contributed to the abdominal distension.
- One of the washout lines had been pulled and may have also contributed to the abdominal distension.
- There was substantial perfusate loss through the lungs. Part of the patient's agonal phase was described as "flash pulmonary edema", however loss of perfusate through the lungs always occurs.
- The swelling of the abdominal cavity pushed the heart up out of the chest.
- Near the end of the cryoprotection, an equipment failure resulted in perfusion pressures possibly as high as 350 mmHg.
- Table loss of perfusate was not as severe as it normally is; approximately 20 liters made it to the effluent reservoir (~33 liters leaked from the patient onto the table). Because of table losses, we did not pause at 50%.
- 17 hours from pronouncement to beginning of cryoprotection is into the grey area where vascular permeability opens up.
- Used: M22x1.25, 65 liters.



9. Timelines - An approximate timeline of events compiled from multiple sources is below.

Stabilization Timeline:

March 25th, 2011 (Times are Eastern Standard Time)

- 12:15 Patient pronounced
- 12:20 Physician grants permission for Alcor to begin procedures
Small volume medications pushed through existing PICC line
200 mg Propofol administered
100,000 IU Heparin administered
250,000 IU Streptokinase administered
- 12:21 15 mg Ketorolac administered
80 mg Gentamicin administered
300 mg Acetylsalicylic Acid in 10 ml Tham administered
- 12:22 60 ml citrate dextrose bolus given to flush medications
- 12:24 Patient rolled onto side and rectal occlusion device inserted and secured
- 12:27 Patient rolled back on to Mega-mover transport fabric
Patient moved to portable ice bath
- 12:30 Lucas 2 ACD cardiopulmonary device aligned over chest and started
- 12:33 Additional ice added to completely cover patient
- 12:35 Thermocouple probes placed and secured in nasopharynx
DualLogR data recording began
- 12:38 Established advanced airway with #4 King esophageal airway
- 12:41 250 ml Maalox administered through gastric tube
- 12:45 Intraosseous access gained through left tibial plateau with Bone Injection Gun
- 12:47 Initial bolus of 1 mg Epinephrine and 20 IU Vasopressin administered
Baxa infusion pump started with 29 mg Epinephrine and 180 IU Vasopressin
- 12:49 400 mg SMT (S-methyl-isothiourea) in 50ml Citrate-Dextrose administered
- 12:51 2.0 g Niacinamide-Kynurenine sulfate in 100 ml Citrate-Dextrose administered
- 12:54 70 ml Vital Oxy administered
- 12:58 250 ml Hetastarch administered
- 13:03 Lucas 2 battery replaced and unit plugged into AC port in wall
- 13:06 100 ml Tham (Tris (hydroxymethyl) aminomethane) administered
- 13:14 500 ml 20% Mannitol administered
- 13:28 Additional ice added from hospital's ice machine
- 13:35 Obtained physician signed death certificate and release documentation from hospital
- 13:50 SA team arrived at hospital
- 14:15 Mortuary representative called to confirm their arrival at hospital
Security staff escorted team and patient through hospital to loading dock

- 14:30 Arrived at loading dock
- 14:35 Loaded ice bath and secured it to the interior of mortuary transport vehicle
- 14:45 Patient and SA team depart for mortuary
Aaron and Steve return to patient's room to begin packing supplies

Field Washout Timeline:

- 15:55 Patient arrives at funeral home, LUCAS no longer running
- 16:10 Move patient to washout room using carts, lift and staff
- 16:29 Patient is being prepped for surgery
- 16:42 Adding more ice to patient
- 16:45 First incision made
- 16:53 Bleeding, old clots, metallic pieces noted in catheterization site
- 17:07 Temp 12.4°C nasal
- 17:11 Alcor team members arrive at funeral home
- 17:42 Cannulae in and secured, 19Fr arterial and 17Fr venous
- 17:53 A/V loop connected to cannulae
- 17:56 Suction used to facilitate washout. Flash noted
- 18:00 Flowing forward
- 18:07 Arterial temp 2°C, venous temp 7.7°C and nasopharyngeal 7.8°C
- 18:17 Arterial temp is 2.8°C and venous temp is 6.6°C
- 18:18 Finish off first bag of MHP2
- 18:23 Circuit closed and 30ml of Vital Oxy added
- 18:27 Arterial temp 1.7°C and venous 4.7°C
- 18:33 Nasopharyngeal temp is 2.4°C
- 18:47 Pump Stopped
- 18:48 Arterial temp 1.3°C and venous temp 4.1°C. Nasopharyngeal temp 1.4°C
- 18:49 Venous cannula becomes dislodged during cleanup
- 19:15 Patient is moved off table into body bag
- 19:43 Patient in transport vehicle and ice is added to body bag
- 20:20 Arrive at chartered jet area Philadelphia airport
- 20:41 Patient loaded on jet to Scottsdale

Surgical Timeline:

March 26th, 2012

- 01:00 Move patient from gurney to surgical table
- 01:05 System pressure 4 psi, 0.98 lpm
- 01:06 Jerry bringing more bagged ice
- 01:08 Hugh checks nasopharyngeal TC DuaLogR 3.1°C

01:09 SteveG disconnects DualLogR
 01:10 Nasopharyngeal connected to computer; 5.1°C
 01:11 Additional ice placed around body. SteveG begins shaving head
 01:13 Hugh cuts away surgical gown
 01:14 Aaron assisting surgery.
 01:21 Prep for burr hole
 01:25 Begin burr hole (Bruce)
 01:26 Begin second burr hole
 01:28 Nancy begins removing debris from burr hole
 01:31 Burr holes finished
 01:32 Aaron begins prep for median sternotomy
 01:35 Begin median sternotomy
 01:37 Hugh replacing arterial thermocouple with broken wire
 01:41 Start cutting sternum
 01:42 Chest open. Hugh having issues with thermocouple
 01:46 SteveG setting up suction
 01:49 Suction running
 01:51 Insert canula into ascending aorta
 01:55 Nasopharyngeal temp 4.7°C
 02:01 Priming aortic cannula
 02:05 Cannulating right atrium
 02:09 Priming cannula
 02:12 Tying in cannulas
 02:17 Hook up arterial cannula to perfusion circuit
 02:18 Hook up venous cannula to perfusion circuit
 02:22 Clear bubbles, unclamp cannulas, close bypass to go on pump
 02:24 Pump 1.2 lpm, 90 mmHg
 02:26 Nasopharyngeal 6°C
 02:27 End washout, close circuit, start ramp. 1.68 lpm, 110 mmHg.
 System pressure 7 psi
 02:30 Hooked up M22x1.25 bladder; Now we're on the ramp. Take
 arterial and venous samples 9.0 Brix
 02:35 Reservoir volume dropping
 02:36 Inserting burr hole temp probe and crackphone elements
 02:41 Nasopharyngeal 4.7°C
 02:45 Reduce ramp speed to 2, open withdrawal. Reservoir volume 7.5 l,
 (down from 8). Pump to 2.35 lpm, 120 mmHg. Flow rate 2.38 lpm,
 120 mmHg. Arterial 18.2, venous 13.8
 02:52 Recall Nancy to try and deal with femoral leakage. Femoral wound
 extends past femoral crease and there is a hole through the abdominal
 wall. Sealed up wound with suture. Only one cannula in place
 02:55 Losing volume to femoral wound. Reservoir volume 4 liters. Ramp
 speed to 6, clamped off withdrawal.
 02:57 Also, lungs leaking. NOTE: died from massive ("flash") pulmonary
 edema, had around 1:45 on thumper. ~160 mmHg, 2.38 lpm. Pump
 to 1.64 lpm, 115 mmHg

03:00 1-2 ml/min estimated leakage form ET tube, 2-3 ml/min from nose. Lungs firm ("like a rock") pulmonary edema, Arterial 23.7, venous 19.3

03:01 Reservoir volume 5 liters

03:06 1.64 lpm, 110 mmHg, temp 4.0°C

03:15 Arterial 30.4, venous 26.2, left burr hole 33

03:17 Odd refractometer reading from left burr hole; high than arterial

03:20 Switch bag of M22

03:23 Replaced M22x1.25 bladder (partial - had 10-25 liters) Reservoir down to 4 liters. Ramp is addition only (withdrawal closed)

03:26 Blotching noted on the skin; head, left leg

03:29 Skin on head swelling. Eyes swollen, not retracting. Left burr hole extruding a little

03:30 Arterial 35.9, venous 32.8, burr hole 35.8

03:31 Reservoir starting to foam. Reservoir volume 3.5 liters. 1.64 lpm, 150 mmHg. Full speed on ramp addition (9.6)

03:33 Reducing pump speed to 0.99, 100 mmHg

03:36 Stop ramp, got to -3°C

03:38 Close up OR table box, start fans, go to -3°C on reservoir and patient, go to -3°C on chiller. NOTE: not doing halfway pause because of table losses, reservoir level

03:43 Remove extra ice from around body

03:45 Refractive index. 0.99 lpm, 110 mmHg, naso 3.1

03:46 Reservoir volume 7.5 l. 0.99 lpm, 110 mmHg

03:50 Head skin not changing, ambering uneven. Reduce ramp addition speed to 7. Reservoir volume 8.5 liters

03:56 Ramp addition speed to 5. Reservoir volume 9.2 liters. 0.99 lpm, 118 mmHg

04:00 Reservoir up. Art 46.1, ven 42.5, Lbur 46.7, Rbur 43.6

04:02 Abdomen full and tense. Pump speed 0.99, 130 mmHg. Pump speed 0.80, 112 mmHg. Chiller to -5°C

04:05 Open ramp withdrawal line. Left leg severely dehydrated, bruises showing

04:09 Brain check: about the same - just into burr holes

04:12 New 20 liter bladder M22x1.25

04:15 Art 47.8, Ven 44.8, Lbur 49.2, Rbur 47.6

04:20 Pharyngeal temperature dropping (-0.65°C). Brain surface -0.85°C

04:30 Art 50.1, Ven 46.2, Lbur 50.6, Rbur 49.7

04:37 Close withdrew line. Reservoir 4.5 l Pump 0.79, 142 mmHg. Pump to 0.66 lpm, --> 125 mmHg. Arms somewhat dehydrated. Heart and lungs swollen. NOTE: emptied table waste ~15 liters. Second waste at 15 liters now. Dumped second waste at 18 liters

04:38 0.79 lpm

04:44 Reservoir 6.5 liters

04:51 Pump to 0.54 lpm

05:09 Pump 0.54 lpm, 116 mmHg. Scalp swollen

05:13 Table dump 18 liters; swap and dump. Effluent 11.7 liters, reservoir 12 liters. Open ramp effluent line
 05:35 Flow to 0.65 NOTE: this is where the Isolator filled up, but we didn't realize it until later. All pressures before that are wrong
 05:43 Close ramp withdrawal
 05:52 Flow to 0.75
 06:10 Flow to 1.00
 06:24 Ramp addition ON speed 5. 1.00 lpm, 80 mmHg. Go to 1.23 lpm. Go to 1.50 lpm --> 100 mmHg
 06:28 Reservoir 4.6 liters, Waste 5.2 liters. Withdrawal (effluent) 19.7 liters
 06:40 Discovered pressure Isolator full. Go to 0.81 lpm. Drained Isolator. Go to 0.52 lpm, 152 mmHg. Go to 0.41 lpm --> 140 mmHg --> 132 mmHg. Problem due to tiny leak on gauge side of Isolator diaphragm
 06:41 Heart being pushed out of chest. Probably combination of full lungs, and full abdomen pushing up diaphragm
 06:43 Ramp off
 06:50 Waste 7.6 liters, reservoir 6.2 liters, effluent 19.6 liters
 07:03 Shutdown. Venous concentration above 50.35 Brix for over an hour. Waste 8.7 liters, reservoir 5.8, effluent 19.6
 07:57 Cooldown to -80°C begins. Pulled cannulas. Put on lifting straps, did not close burr holes or chest. T1=gas, T2=nasopharyngeal, T3=burr hole, T4=room. Crackphone: #1, left, red-orange; right, #2, yellow-green. Set LN2 shot interval to 8 seconds
 08:06 T1=-18.3, T2=-1.0, T3=2.3, T4=17.5
 09:00 Composed most of interim cryoprotection report
 15:21 Pharyngeal temp -54°C

Mar 27

15:14 Pharyngeal temp -78°C

Mar 31

13:38 Begin transfer to pod
 14:02 Plunge to -110°C, begin cooling at 1°C/hr

Apr 03

20:42 Cooldown lid fan stopped due to ice buildup
 20:57 Fan cleared and restarted

Apr 04

22:34 Clear frost from base of cooldown lid fan

Apr 05

15:41 Go to manual cooldown mode to begin LN2 fill (-0.003°C/min from -190°C)

Apr 06

09:16 Clear frost from base of cooldown lid fan
 21:55 Disconnect LN2, go to direct LN2 fill
 22:42 LN2 fill completed

Apr 11

14:57 Transferred patient to permanent care

10. Discussions and Recommendations

Problem: A great deal of time was expended from the time of patient pronouncement to the time the patient was transported to the funeral home. Part of this time was the time it took for the funeral home to pick up the patient for transport and the actual time spent driving to the funeral home.

Solution: Attempts should be made to locate a funeral home within thirty minutes driving time of the patient location.

Problem: The Lucas device ran out of battery during the transport of the patient to the funeral home.

Solution: A person with extra batteries should accompany patient during all transports. If there are no extra batteries an Ambu Cardio Pump should be brought.

Problem: The venous cannula became dislodged after closed circuit perfusion had been discontinued.

Solution: Clamp vessel with cannula inside it in place. Use copious amounts of tape to secure the cannula to the patient's leg.

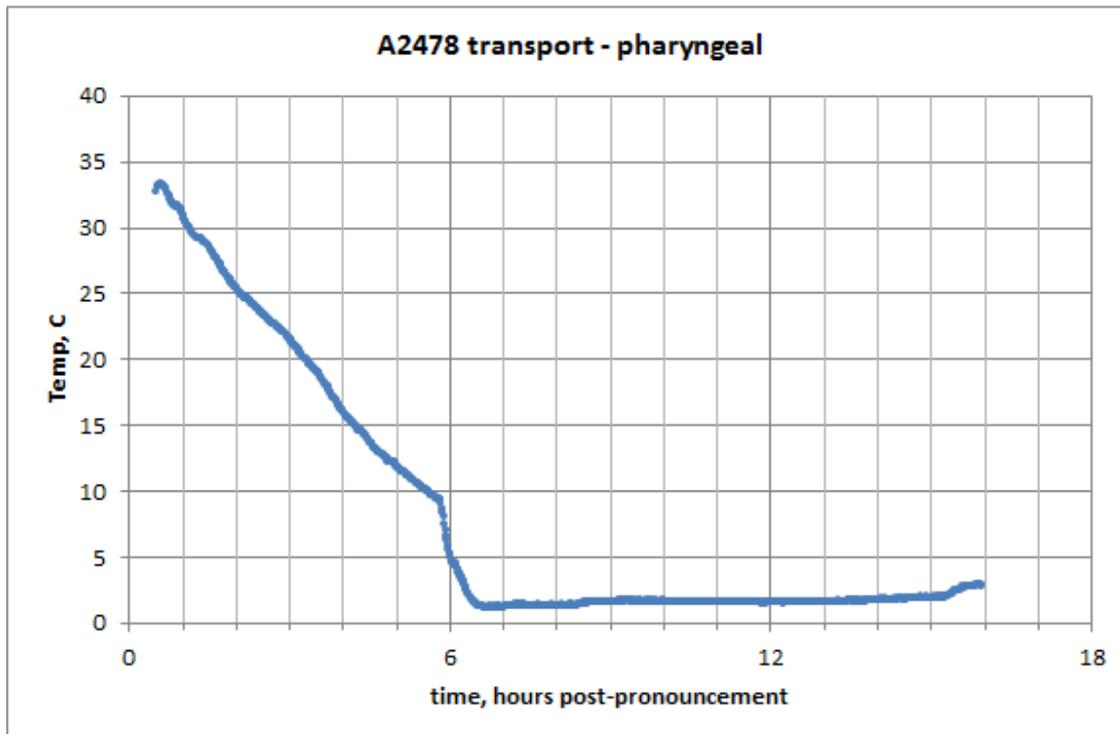
Problem: After close inspection of the body bags, micro cracks were identified. After researching the issue, we determined that near freezing temperatures can cause PVC based body bags to crack. The ice that was contained within our bags for numerous hours must have contributed to creating these cracks.

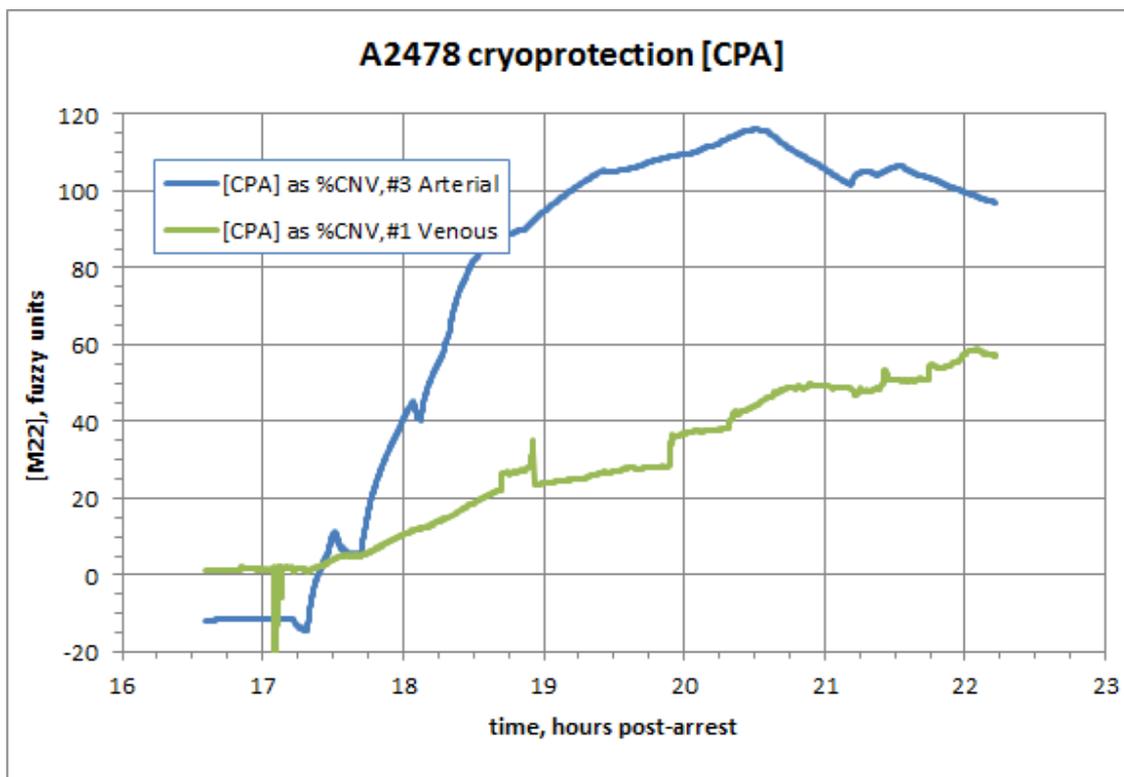
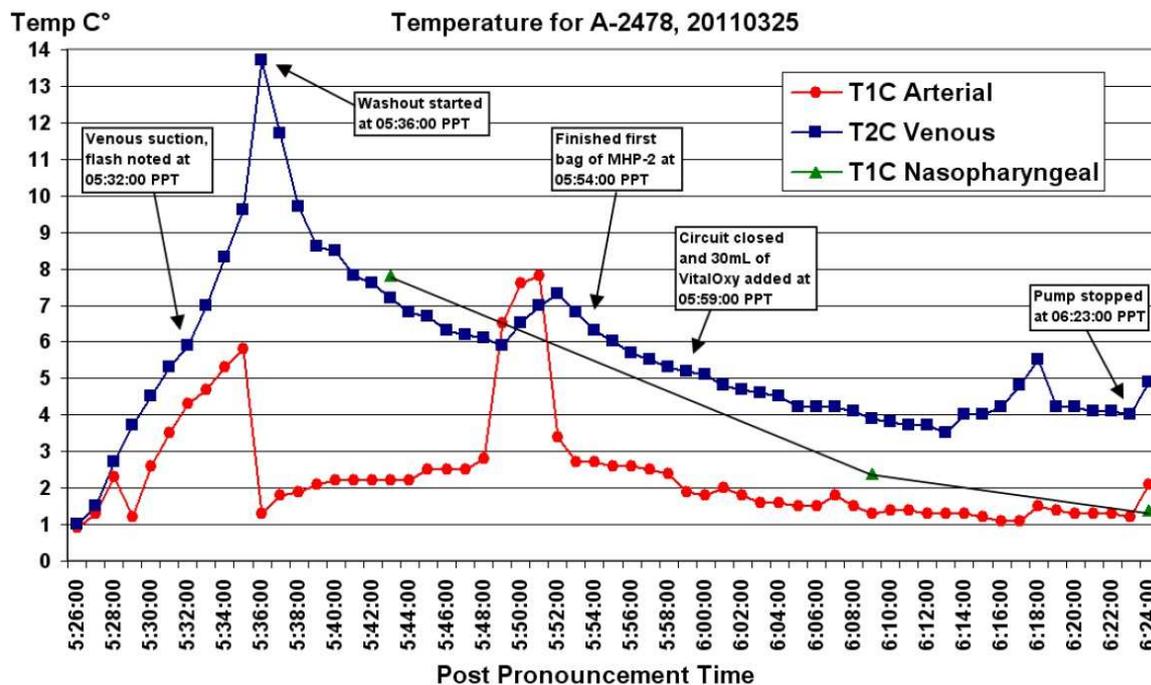
Solution: We have now purchased PVC-free heavy duty body bags that are designed under federal disaster response guidelines.

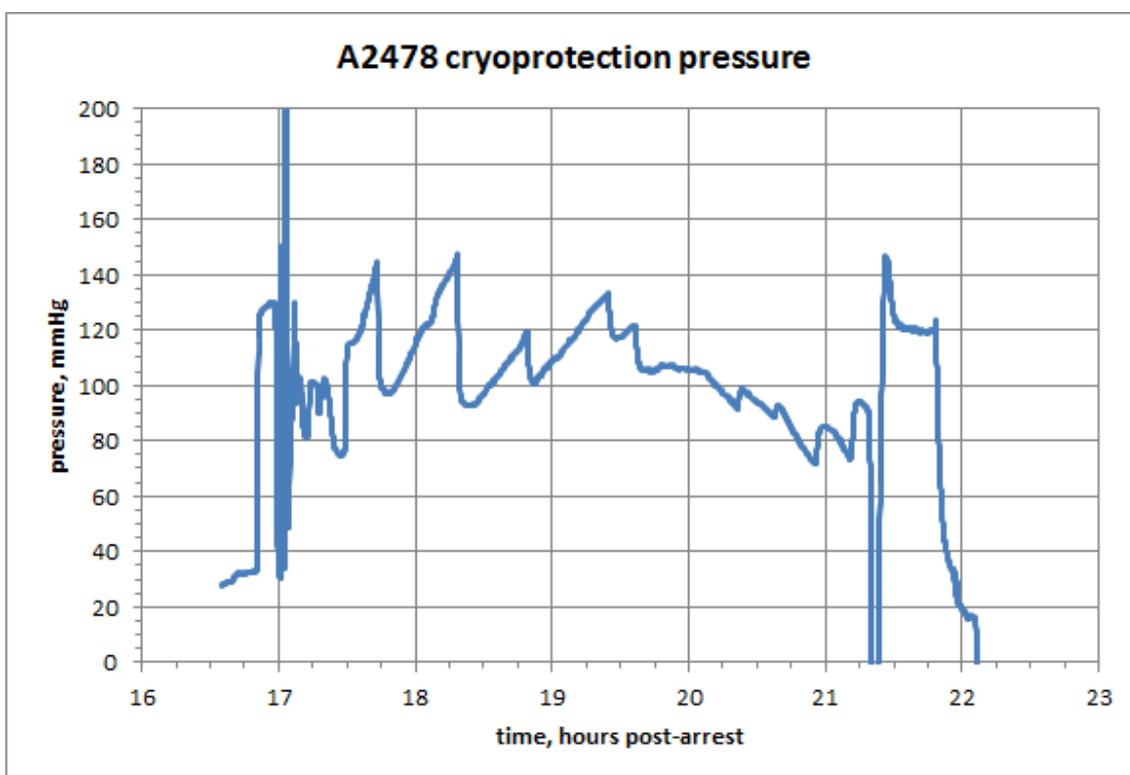
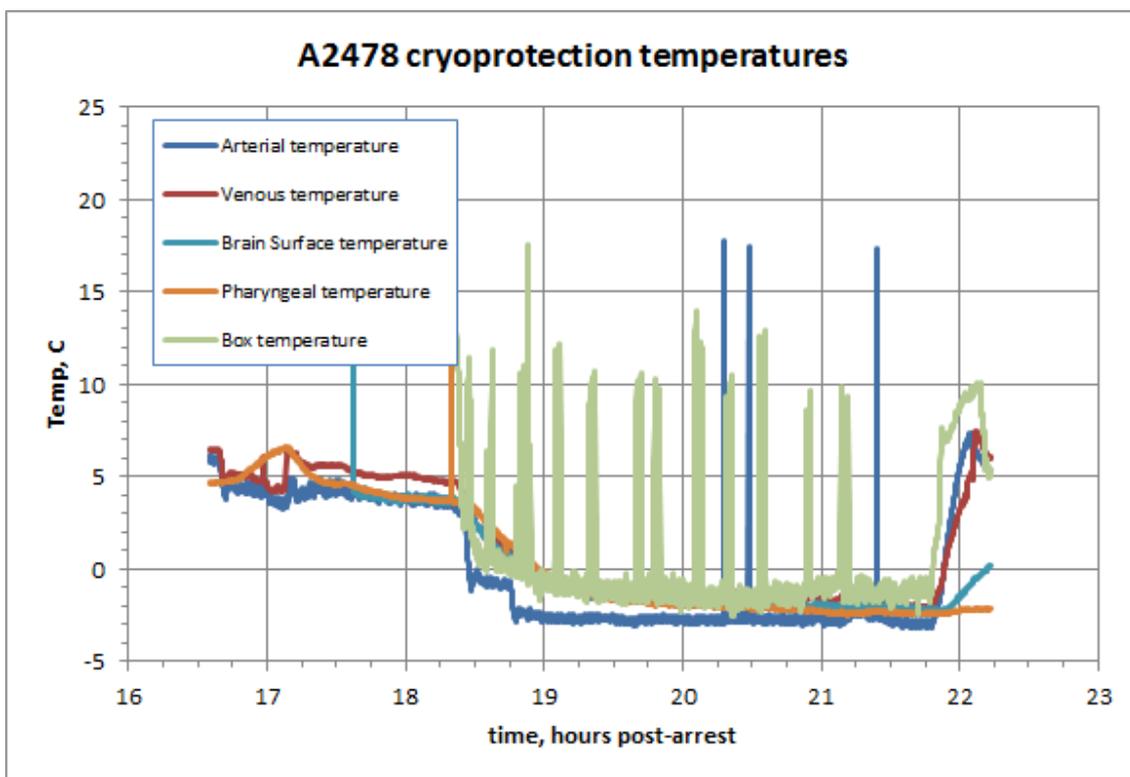
Problem: During the perfusion stage, a tiny leak developed on the gauge side of the Isolator diaphragm. To compensate for the 'apparent' pressure drop, pump speed was increased, increasing the actual perfusion pressure. This led to pressures increasing from 120mm Hg at 05:30 to an estimated 400 mm Hg at 06:40.

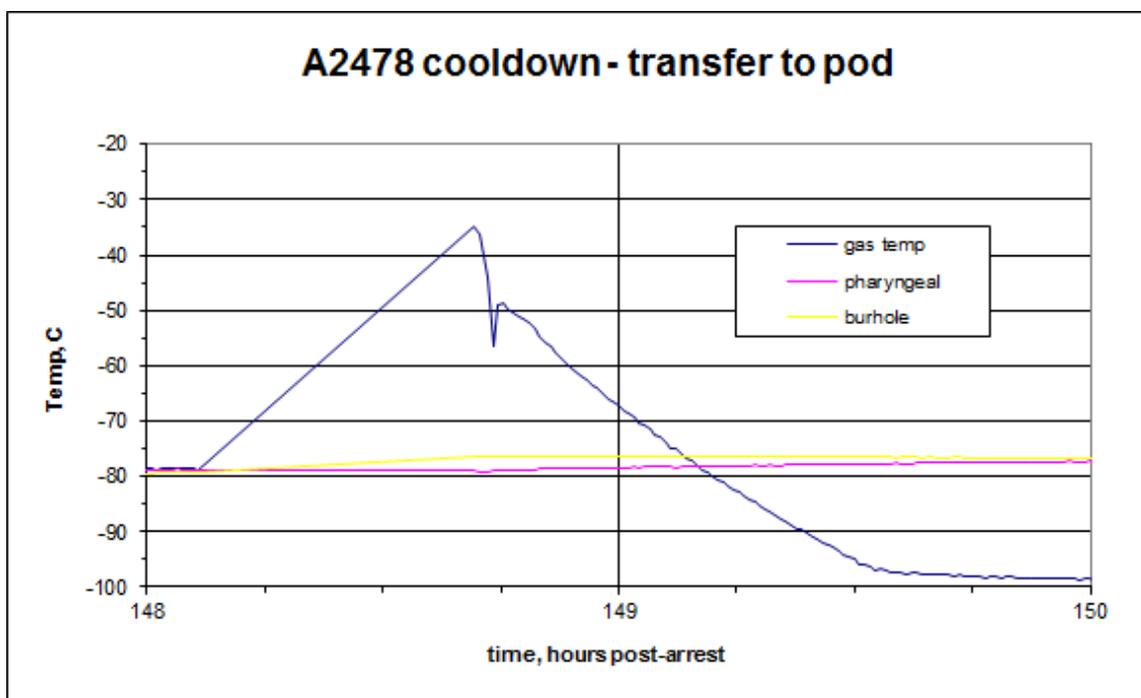
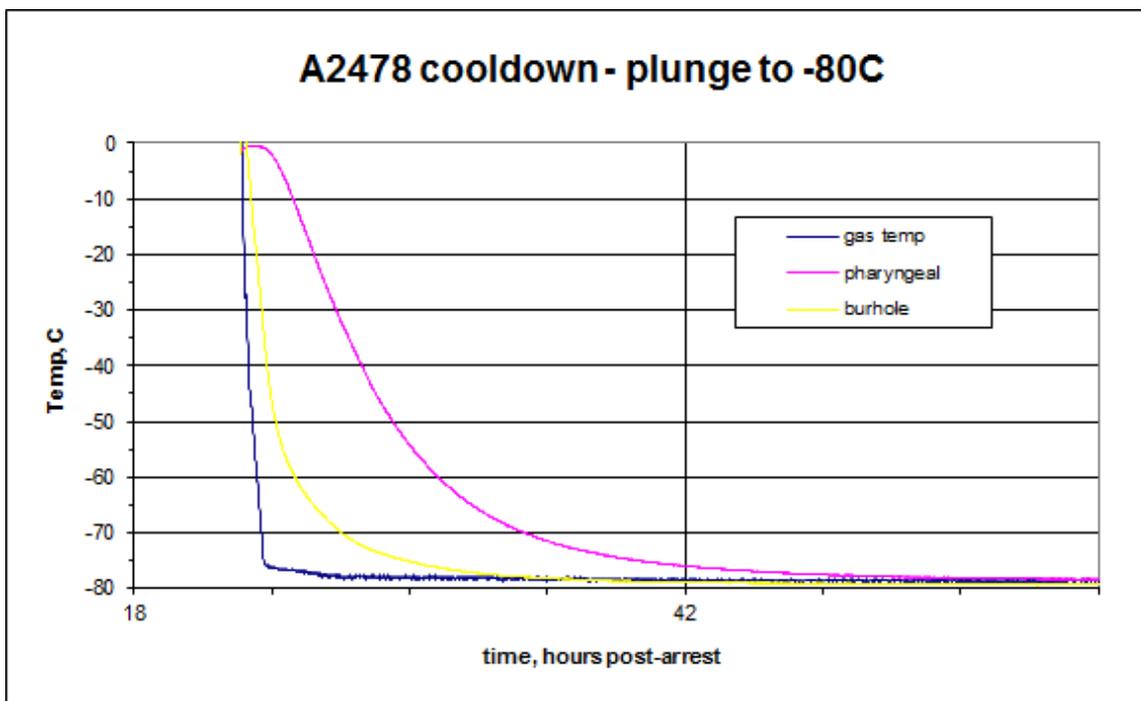
Solution: We will need to more closely watch more for pressure drops and for bulging in the isolator. If the problem occurs again, we will need to disconnect the isolator, blow out the diaphragm and reconnect, before continuing.

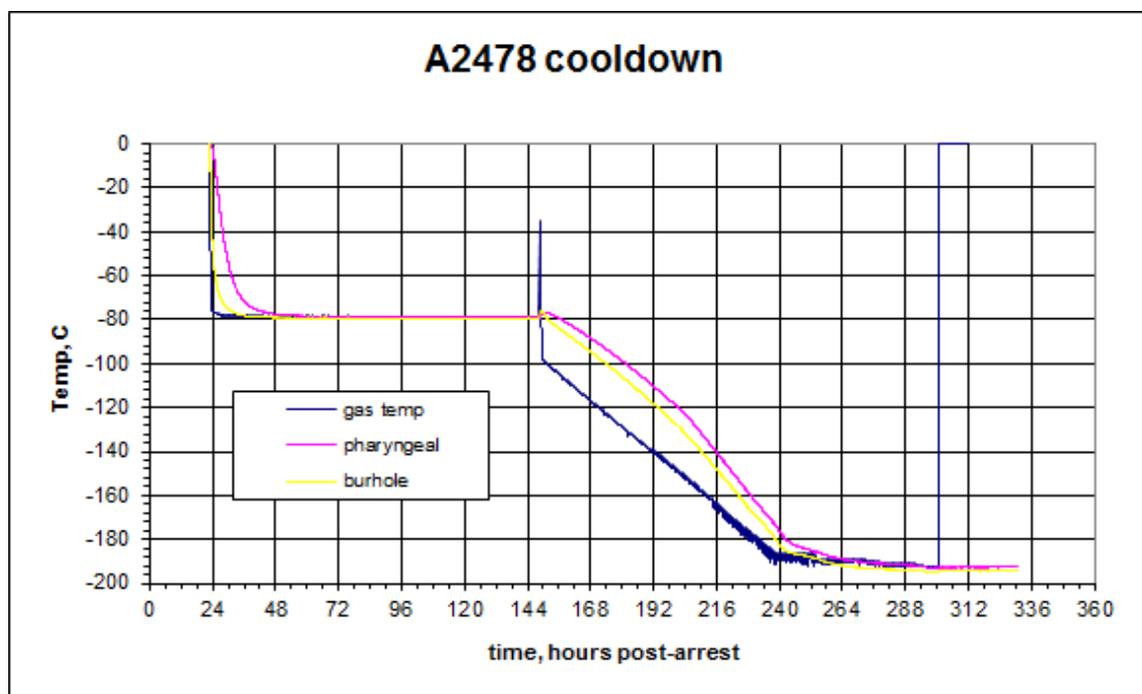
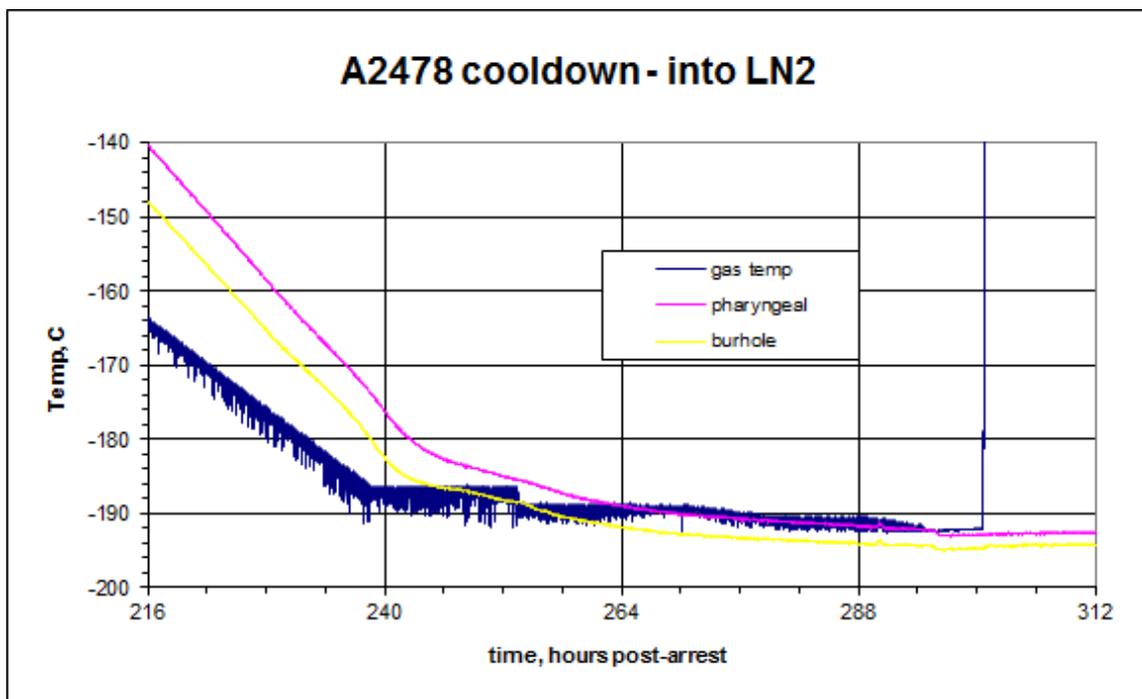
11. Graphs

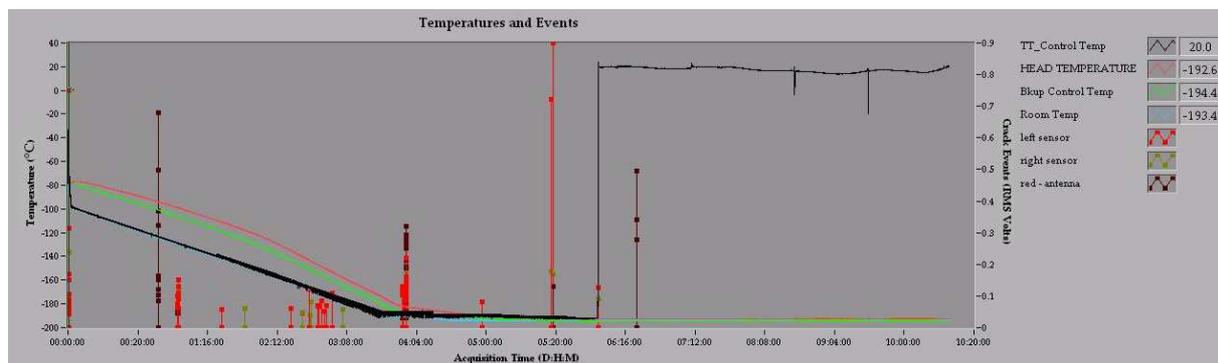












- End of report -