CRYONIC SUSPENSION CASE REPORT: A-1133

Alcor #: A-1133
Patient Name: Redacted
Date of Birth: 02/19/58
Date of Suspension: 08 June, 1987
Report Prepared by: Michael G. Darwin, Jerry D. Leaf, Hugh L. Hixon

Background History

The patient first contacted Alcor through a close friend of his father's, Mrs. Redacted, early in March of 1987. Mrs. Redacted informed us that the patient was terminally ill with acquired immune deficiency syndrome (AIDS) and that both he and his father had a long-standing interest in cryonics which had been reawakened by the patient's terminal condition. After some preliminary communications via Mrs. Redacted the patient accompanied by his father, Redacted Redacted , toured the Alcor facility and received extensive background information on both cryonics and Alcor to establish informed consent.

The patient was advised of the procedures Alcor employs for cryonic suspension, was appraised of the injury those procedures would likely cause and was counseled as to the speculative and uncertain nature of scenarios to reverse such injury.

Discussions over a period of several days resolved some financial issues which stood in the way of the patient becoming an Alcor Suspension Member; the final obstacles in the way of his approval were resolved at the 5 April meeting of the Alcor Board of Directors which Mr. Redacted on and his father attended. On 28 March, 1987 the patient submitted a completed *Application for Cryonic Suspension, Authorization of Anatomical Donation, Consent for Cryonic Suspension, Cryonic Suspension Agreement*, and *Certificate of Religious Belief*. The patient selected the neurosuspension option. On 5 April, 1987, The patient was approved as an Alcor Suspension Member. He subsequently completed a *California Durable Power of Attorney for Health Care* on 9 April, 1987.

Medical History

The patient is a 29-year-old, single, caucasian male with severe hemophilia A no inhibitor, acquired immune deficiency syndrome (AIDS) presumably contracted through contaminated factor VIII concentrate, *Mycobacterium avium* complex, granulomatous hepatitis (with ascites) presumably secondary to *M. Avium*, oral and esophageal candidiasis, who deanimated secondary to presumed bacterial septicemia (no positive blood cultures were ever obtained). The patient's past medical history is remarkable for many previous hospital admissions (55 admissions to Los Angeles Orthopaedic Hospital alone) with a wide range of complaints: severe, recurrent headaches, disconjugate position of the eyes (neurological exams, including MRI, were negative), multiple bacterial infections, dependency on and abuse of narcotics/sedatives (phenobarbital, methadone, dilaudid), labile hypertension, renal dysfunction, and a history of lower right-lobe pneumonitis.

On 6/6/87 the patient was taken to the Emergency Room of Orthopaedic Hospital by his father where he presented with an elevated temperature and some disorientation. The medical record documents his admission at 13:15 with a temperature of 40 °C, blood pressure of 80/40 and a pulse of 120. At the time of admission the patient's mental

status was reported as mostly disoriented but occasionally appropriate.

Physical Exam:

The admitting physical exam: HEAD, EYES, EARS, NOSE, and THROAT (HEENT): Icteric sclera, disconjugate position of the eyes, normal pupils and fundi. Ear canals and tympanic membranes normal. Oral candidiasis (mild). No remarkable lymphadenopathy. LUNGS: Clear. HEART: Rate 120 and regular. Blood pressure 86/46 supine. ABDOMEN: Total liver span estimated at 16 cm. with spleen tip approx. 3 cm. below the left costal margin. Tender periumbilicum with no guarding or rebound. Bowel sounds normally active.

Laboratory evaluations disclosed a potassium of 5.7 mEq/dl, a sodium of 142 mEq/l, a chloride of 104 mEq/l and calcium of 7.5 mg/dl. The complete blood count (CBC) disclosed a white blood cell count (WBC) of 2.0×10^3, red blood cell count of 2.96×10^6, hemoglobin of 10.2 g/dl, mean corpuscular volume (MCV) of 101.2 μm3, MCH (mean corpuscular hemoglobin) of 34.6 pg, MCHC (MCH concentration) of 34.1 g/dl, RDW of 18%, and a PLT (platelets) of 80×10^3.

The patient was started on Cefobid (cefoperazone), 2 gm. bid. for presumed sepsis of unknown etiology, and transferred to a regular nursing floor. Over the next 24 hours he developed hepatic coma and became obtunded and responsive only to painful stimuli. It was the judgment of the attending physician, Dr. Laurence Logan, that the patient was in irreversible hepatic coma and would not recover, and he was therefore given "no-code" status.

On 6/7/87 the patient was seen by Alcor physician Dr. Steven Harris. Dr. Harris's examination was prompted by the absence of (and inability to locate) Alcor Suspension Team leader and perfusionist Jerry Leaf. Mr. Leaf's absence necessitated a careful assessment of the patient's condition by someone sympathetic to Alcor's objectives. Dr. Harris' examination noted that the patient was obtunded, markedly icteric, and in apparent hepatic coma with probable complicating septic shock. Dr. Harris felt that the patient might yet survive this crisis with appropriate antibiotic therapy (the Cefobid provided coverage for only gram-negative organisms) and ICU supportive care. After consultation with Dr. Logan, the patient was transferred to the ICU and placed on a cardiac monitor. At 13:40 on 6/7/87 IV fluid and pressor support was initiated with the administration of a 500 cc bolus of D5W/NS followed by a continuous infusion of same at a rate of 150 cc/hr. A dopamine drip was also begun (400 mg dopamine in 250 cc NS 10 cc/hr. titrated prn up to 40 cc per hour) to support blood pressure. Vancomycin, 1 gm, was given IV to provide coverage against gram-positive organisms.

At 03:30 on 6/8/87 the patient experienced cardiopulmonary arrest following IV administration of dilaudid for pain, and was pronounced legally dead in the ICU. The Alcor Transport Team was standing by and began cardiopulmonary support.

Transport

The patient was intubated by the on-call Emergency Room physician who pronounced legal death in the ICU. Cardiopulmonary support (CPS) was begun at approximately 03:40 using a Brunswick Heart-Lung Resuscitator (HLR) 50-90: 60 compressions 1-1/2" sternal deflection (95 lb force setting) with twelve 1500 cc ventilations per minute via endotracheal tube. The patient was then transferred to an ambulance cot, removed from the hospital, and loaded into the Alcor ambulance for transport to Alcor's cryonic suspension facilities in Riverside, CA.

External cooling was begun at 03:44 using Zip-Loc polyethylene bags containing crushed ice. Jerry Leaf arrived while the patient was being loaded and began administration of transport medications at approximately 04:00. All transport medications were given IV as follows: 21,000 I.U. sodium heparin at 04:27; 100 gm mannitol in 500 cc water; 7.5 mg verapamil at 04:25; 2 mg naloxone at 04:26; 4.0 mg metubine iodide; 300 mg cimetidine; 1 gm erythromycin; 400 cc 5% dextran 40 in D5W; 36 gm tromethamine (THAM). Infusion of THAM and dextran-40 were completed at 06:03 shortly after the patient's arrival at the Alcor facility.

The first temperature obtained was a pharyngeal temperature of 28.5°C at 05:51 shortly after arrival at Alcor. Temperature was monitored with a Shiley TMI temperature monitor employing vinyl coated copper-constantan (type T) thermocouple probes. At 06:23 there was a 3-5 minute period of manual CPS due to a HLR malfunction which necessitated replacement of the HLR driver unit. The HLR malfunction was a "cadence" malfunction with the HLR missing a compression during each cycle. The driver unit was replaced with a back-up unit without any interruption in chest compressions: manual chest compressions were used as a bridge until the unit was replaced.

At approximately 07:00 fulminating pulmonary edema was noted as evidenced by the presence of moderate amounts of blood-tinged foam in the endotracheal tube. The ET tube was repeatedly suctioned. At 07:41 the patient was accidentally extubated during transfer from the ambulance cot to the Mobile Advanced Life Support System? (MALSS) unit gurney. Bag-valve-mask ventilation was used as a bridge until an esophageal gastric tube airway was placed. The patient's pharyngeal temperature was 21.9°C at the time of accidental extubation.

Perfusate Preparation

The composition of the base perfusate is given in Table I. Dry chemical perfusate components were prepared from reagent or medical grade chemicals weighed out using an Ohaus Centogram model 311, and Ohaus Triple Beam 2610 g balances. Dry components were mixed with ACS reagent grade glycerol and/or sterile water for injection USP, or sterile water for irrigation USP. Perfusates were sterilized by filtration into the concentrate or recirculating reservoir of the extracorporeal circuit through a Pall PP3802 0.20μ pre-bypass filter. Perfusate was prepared in three batches with the following volumes, osmolalities, and glycerol concentrations:

Volume	Glycerol %(w/v)	mOsm
20 l	0%	329
10 l	5%	680
10 l	50%	---

TABLE I

Base/Cryoprotective Perfusate

Component	*Molar Concentration (mM)*	*g/l*
Mannitol	170	55
Glucose	10.0	1.80
HEPES (Na^+ salt)	7.2	1.87
Glutathione	5.0	1.54
Sodium Bicarbonate	10.0	0.84
Adenine HCl	1.0	0.17
Potassium Chloride	28.3	2.11
Calcium Chloride	1.0	0.5 ml of 22.2% soln.
Magnesium Chloride	2.0	1.0 ml of 40.66% soln.
Hydroxyethyl Starch	--	55.0
Heparin		1000 units/l

pH adjusted to 8.0 with potassium hydroxide.

mOsm: 338 (measured).

Cryoprotective perfusate was prepared by dissolving the above components in either 5% (w/v) glycerol in water for injection or 50% (w/v) glycerol in water for injection.

MALSS Support

Femoral Cannulation

The patient's right groin was prepared for femoral cut-down by scrubbing/swabbing with povidone iodine solution (Betadine) and draping with sterile towels. The anatomical position of the right femoral artery and vein were located by reference to the pubic tubercle and the anterior superior iliac spine. An incision with a #10 scalpel blade was made at the midpoint between these two structures, beginning with the inguinal ligament and running parallel to the longitudinal axis of the leg for approximately 5 cm.

The femoral artery and vein were dissected free and #2 silk ties placed on proximal and distal exposures of both vessels. The distal ties were tied to achieve occlusion.

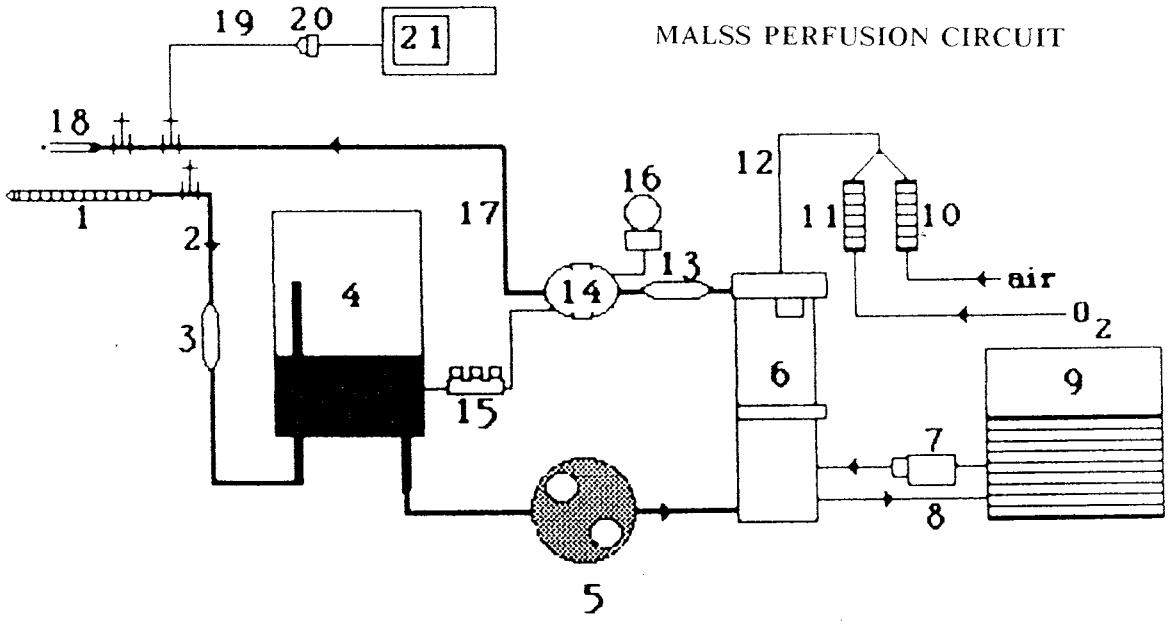
An arteriotomy was made with with a #11 scalpel blade and a USCI Type 18S8-S, 20 Fr. arterial cannula was introduced and secured with the proximal tie. A veinotomy was performed in the same fashion and a USCI type 1967, 30 Fr. venous cannula was advanced until the tip was well within the inferior vena cava near the heart and secured with the proximal tie. Capillary blood oozing from the tissue and arterial blood observed during the arteriotomy was noted to be bright red and apparently oxygen-saturated. There was a visible femoral arterial pulse.

The arterial perfusion line was connected to the arterial cannula with a 3/8" straight connector with port, and the port fitted with a Cobe 3-way stopcock for

evacuation of air and attachment of a Cobe 8' pressure monitoring line. The pressure monitoring line was connected to a Trantec Model 800 pressure transducer. Trans-cannula pressure was monitored with a Tektronix Model 412 monitor.

The venous return line was connected to the venous cannula with a 1/2" straight connector with port and air removed from the venous cannula and venous line with a 35 cc plastic syringe.

Femoral-femoral cardiopulmonary bypass was initiated at 08:03 on the MALSS employing a Travenol 5M6202 roller pump, SciMed II model SM 35 membrane oxygenator (3.5 M2 surface area), and a Shiley SAF-20, 20μ blood filter. A complete description of the MALSS is presented as an addendum. The extracorporeal circuit is presented in schematic below:



1) Cannula (Venous) and Stopcock
2) Venous Return Line
3) Venous Oxygen Saturation Cuvette
4) Venous Reservoir (Sci-Med RV-1500)
5) Roller Pump
6) Membrane Oxygenator (Sci-Med SM-35)
7) Water Pump and Line to Heat Exchanger
8) Water Return Line
9) Reservoir (Ice Water)
10) Flowmeter (Air)
11) Flowmeter (Oxygen)
12) Gas Line to Oxygenator
13) Arterial Oxygen Saturation Cuvette
14) Filter (Arterial)
15) Stopcock Manifold (3-gang, Cobe)
16) Manometer (Aneroid) System Pressure
17) Arterial Line
18) Cannula (Arterial) and Stopcock
19) Trans-Cannula Femoral Artery Pressure Line
20) Transducer (Pressure)
21) Monitor (Pressure)

The extracorporeal circuit was primed with 1 liter of Normosol R, 500 cc of Hespan, 44.6 mEq of sodium bicarbonate (50 cc), and 2500 I.U. of sodium heparin. (The composition of Normosol R and Hespan are given in Tables II & III.) Bypass was initiated at a blood flow rate of 1.2 liters per minute and an oxygen flow rate of 5.0 liters per minute. Trans-cannula arterial pressure was 140 mmHg (measured before the cannula). Adjusting for

pressure drop across the cannula yields a systemic perfusion pressure of 70 mmHg. At the start of extracorporeal circulation ventilation and chest compression were discontinued and the mask of the Esophageal Gastric Tube Airway (EGTA) was removed (the obturator was left in place to guard against aspiration).

TABLE II
Normosol R

Component	*g/l*
Sodium Chloride	5.26
Sodium Acetate	2.22
Sodium Gluconate	5.02
Potassium Chloride	0.37
Magnesium Chloride	0.14

water for injection qs

295 mOsm/l (calculated)

pH adjusted to 7.4 with less than 1 mEq/l hydrochloric acid or sodium hydroxide

Table III

Hespan

Component	*g/l*
Sodium Chloride	9.0
Hydroxyethyl Starch	6.0

Water for injection qs.

pH adjusted to 5.0 with sodium hydroxide

310 mOsm/l (calculated).

Hemodilution/Blood Washout

Hemodilution with base perfusate (composition given in Table I) began at 08:28 with the patient's temperature at approximately 17°C and consisted of slow infusion of 2 liters of chilled base perfusate into the venous reservoir with intermittent drainage of 1-liter volumes from the recirculating loop as the reservoir became over-filled. A blood/perfusate sample drawn from the venous reservoir at the end of the first 2-liter exchange disclosed the following:

pH	6.62
HCT	10
SGOT	356 IU/l
SGPT	37 IU/l
Total Bilirubin	1.0 mg/dl
Direct Bilirubin	0.5 mg/dl
Indirect Bilirubin	0.5 mg/dl
BUN	28.0 mg/dl
Creatinine	1.8 mg/dl
Cholesterol	10 mg/dl
Alkaline Phosphatase	53 IU/l
Glucose	225 mg/dl
Phosphorus	8.5 mg/dl
Calcium	4.0 mg/dl
Total Protein	0.9 g/dl
Albumin	0.2 g/dl
Globulin	0.7 g/dl
Sodium	78 mEq/l
Potassium	20.4 mEq/l
Chloride	71 mEq/l
CO_2	2 mEq/l
Creatine Phosphokinase	610 IU/l
gamma-GT	2 IU/l
Uric Acid	3.0 mg/dl
Lactate Dehydrogenase	304 IU/l

The second 2-liter exchange was begun at approximately 08:40 and completed at 08:56, the third 2-liter exchange was begun at approximately 08:42 and was completed at 09:00, the fourth and final 2-liter exchange was begun at 09:33 and was completed at 09:40. The hematocrit at the end of the fourth exchange was 3 and the patient's esophageal temperature was 5.2°C. A total of 8 liters was used in the flush/exchange. The venous pH increased from 6.62 near the start of MALSS support to 6.89 at the conclusion.

At 09:45 copious amounts of blood-tinged fluid were observed to have begun draining from the mouth and nose. As the obturator of the EGTA was still in place, the likely source of this fluid was the lungs. By 09:50, despite repeated suctioning, fluid drainage (apparently as a result of pulmonary edema) was becoming unmanageable. At 09:51 extracorporeal circulation was discontinued due to this fluid leakage. The patient was allowed to "exsanguinate" into the venous reservoir of the oxygenator, the connections between the cannula and the circuit were broken, and the arterial and venous cannula were connected to each other with a 3/8" straight connector.

A laboratory sample taken at the conclusion of MALSS support revealed the following:

HCT	3
SGOT	304 IU/l
SGPT	30 IU/l
Total Bilirubin	0.7 mg/dl
Direct Bilirubin	0.3 mg/dl
Indirect Bilirubin	0.4 mg/dl
BUN	24.0 mg/dl
Creatinine	1.5 mg/dl
Cholesterol	10 mg/dl
Alkaline Phosphatase	35 IU/l
Glucose	204 mg/dl
Phosphorus	6.5 mg/dl
Calcium	3.9 mg/dl
Total Protein	0.9 g/dl
Albumin	0.1 g/dl
Globulin	0.8 g/dl
Sodium	67 mEq/l
Potassium	23.4 mEq/l
Chloride	66 mEq/l
CO_2	3 mEq/l
Creatine Phosphokinase	586 IU/l
gamma-GT	1 IU/l
Uric Acid	2.3 mg/dl
lactate Dehydrogenase	251 IU/l

The patient was transferred to the operating table which had been previously prepared with a cooling blanket placed atop 2"-thick egg crate foam. The temperature of the water circulating in the cooling blanket (Blanketrol Unit) was set to 0°C and the patient was packed in ice from head to foot.

Gross Assessment

After the patient was on the operating table he was briefly examined. The exam disclosed a thin, caucasian male in his late 20's. The arms and calves were thin, the abdomen slightly distended with a palpable "fluid wave." The eye exam was remarkable for globes somewhat retracted in their orbits, and conjunctival membranes which were markedly icteric. The pupils were dilated. The buccal mucosa was whitish-yellow and apparently blood-free. The skin was chrome yellow with numerous cyst-like nodules scattered over the abdomen and trunk. There were hyperpigmented areas of skin on the calves and ankles which were reminiscent of skin changes seen in chronic venous stasis "brawny edema." There were also numerous scabs and excoriated areas on the calves and thighs. A scar consistent with prior appendectomy was noted in the lower right quadrant.

Operative Procedures

Pre-operative Prep

The patient was prepared for a median sternotomy and cranial burr-hole by shaving the head and thorax and scrubbing/swabbing them with povidone iodine solution (Betadine). The sternal operative site was defined by draping with sterile towels and an adhesive operative drape (3M) was placed over the sternum. A cardiac drape was placed over the

patient, "tented" on two IV poles at the head and allowed to extend down over the feet and over the sides of the table by a minimum of 24". The top of the scalp was draped with three surgical drapes to define a triangular operative site over the right frontal lobe.

Cranial Burr-Hole

Surgery to open the cranial burr-hole was begun at 14:50. The vertex of the scalp approximately 2 cm to the right of midline over the right frontal lobe was incised with #10 scalpel blade and an incision approximately 4 cm long was made down to the periosteum. A periosteal elevator was used to expose the bone approximately 1.5 cm to the right of the midline. A 10 mm hole was made with a neuro burr and drill. The dura mater was opened and trimmed away with iris scissors to expose approximately 6 to 8 mm of the cortical surface. Burr-hole surgery was completed at 15:10. Upon opening the dura, the cortical surface was seen to be well washed out with no blood-filled pial vessels visible.

Median Sternotomy/Vascular Access

Median sternotomy commenced at 12:48 with an incision over the midline of the sternum with a #10 scalpel blade. Fascia and connective tissue were cleared down to the sternum with an electrosurgical knife. A median sternotomy was then performed with a Stryker oscillating sternal saw. The edges of the sternotomy were padded with laparotomy sponges, a self-retaining retractor placed, and the sternotomy retracted open. Blunt and sharp dissection were used to expose the pericardium. The ascending aorta was freed from the pulmonary artery by blunt dissection with Metzenbaum scissors. An aortic cross-clamp was placed just above the aortic valve to exclude the coronary circulation. A second aortic cross-clamp was applied to the descending aorta just distal to the left subclavian artery in order to exclude any arterial circulation to the body.

The left subclavian artery was identified and followed to locate the left vertebral and mammary arteries. #2 silk ties were placed on the mammary artery and on the subclavian, just distal to the vertebral, and secured to occlude these vessels. This directed flow to the left vertebral supplying the brain, excluding the brachial and thoracic wall circulation.

The innominate artery was located and followed to identify the right subclavian artery. The right subclavian was followed to identify the right vertebral and mammary arteries. Silk ties were placed, as was done over the left side, to direct flow to the vertebral artery.

A ventral midline pericardiotomy was made using Metzenbaum scissors. Four stay sutures of 3-0 silk were placed in the margins of the pericardiotomy. These sutures were tied to the sternal retractor, thereby reflecting the pericardium away, creating a pericardial "cradle" and exposing the heart and aorta for cannulation. A Sarns cardiotomy sucker was used to suction away the pericardial fluid.

A 3-0 Tycron purse-string suture was placed in the aorta and a snare applied. An aortotomy was made with a #11 scalpel blade. A 22 Fr. aortic perfusion cannula was primed with normal saline and a clamp placed on the distal end. The cannula was then introduced into the aorta and snared in place with a hemostat.

A Satinsky partial occlusion clamp was placed on the right atrium just below the apex. A purse string suture of 2-0 Tycron was placed in the atrium and a snare tube applied. An atriotomy was made by removing the apex of the right atrium with Metzenbaum

scissors. A tube clamp was placed on the distal end of the 32 Fr. USCI type 1967 venous catheter and it was advanced through the atriotomy (with concurrent release of the Satinsky clamp) into the right atrium to the superior vena cava. Umbilical tape was passed around the superior vena cava and tied below the cannula tip. In order to prevent contamination of the recirculating system with venous circulation from the extremities, silk ties were placed on the left and right innominate veins just distal to the left and right internal jugular veins. Venous return was collected from the cannula in the superior vena cava.

A third small purse-string suture of 5-0 silk was was placed in the left lateral aspect of the ascending aorta and an aortotomy made with a #11 scalpel blade. A Cobe 3-way stopcock was fitted to an Aloe arterial pressure monitoring catheter, and the catheter was flushed with normal saline and introduced through the aortotomy into the ascending aorta. The catheter was secured in place by applying a snare to the 5-0 suture.

The sterile perfusion tubing was then brought up to the surgical field and secured in a Travenol tubing holder towel clamped to the drapes. The arterial-venous loop of the perfusion circuit was clamped and divided by cutting out the 1/2" - 3/8" adapter with Mayo scissors. A 1/2" connector with a Cobe 3-way stopcock was used to connect the 1/2" ID venous return line to the venous cannula. Air was cleared from the system with a 100 cc glass syringe. A Cobe 8 ft. pressure monitoring line was fitted to the arterial pressure catheter, flushed with normal saline and handed off the field to be connected to the Trantec Model 800 pressure transducer and Statham SC1001 monitor.

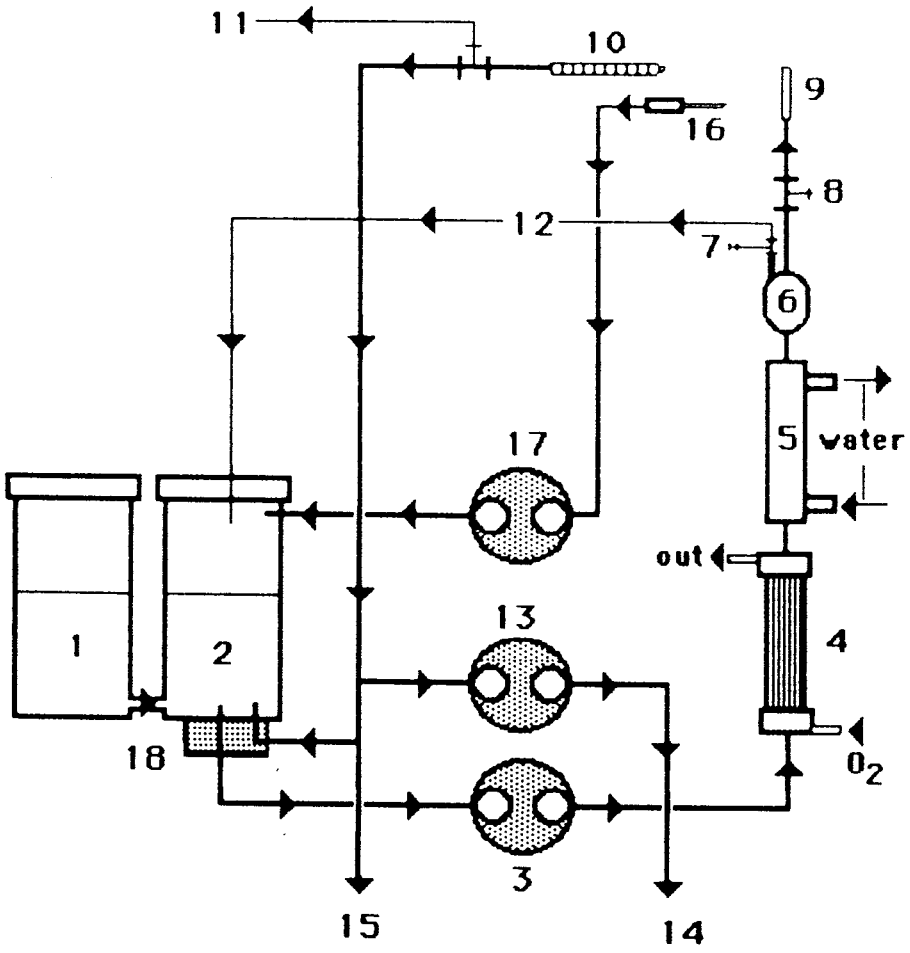
Surgery to connect the patient to the perfusion circuit was completed at approximately 15:40.

Perfusion Circuit

The extracorporeal circuit for cryoprotective perfusion is shown in schematic below. The circuit consisted of two parts: a recirculating system to which the patient was connected, and a cryoprotective addition system which was connected to the recirculating system. The recirculating system was a 20 liter reservoir sitting atop a magnetic stirring table, an arterial (recirculating) roller pump, an Erika HPF 200 hemodialyzer which was used as a hollow fiber oxygenator, a Sarns Torpedo heat exchanger and a Pall EC1440 40 micron blood filter. The recirculating (mixing) reservoir was continuously stirred with a 2" teflon coated magnetic stirring bar driven by a Thermolyne type 7200 magnetic stirrer. The cryoprotective addition system consisted of a 20-liter polyethylene reservoir containing 50% (w/v) glycerol (see Table I) and a Drake-Willock model #7401 hemodialysis pump acting as a withdrawal pump which removed perfusate from the recirculating system, causing 50% (w/v) glycerol perfusate from the concentrate reservoir to flow under gravity into the recirculating reservoir.

Arterial and venous samples for evaluation of chemistries and glycerol concentration were drawn at 15-minute intervals during cryoprotective perfusion. Arterial samples were drawn from a 3-way stopcock interposed between the arterial filter and the filter vent line. Venous samples were drawn from a 8' Cobe monitoring line connected to a Cobe 3-way stopcock attached to the venous connector connecting the venous cannula and the venous return line. (The dead-space of the Cobe monitoring line was determined and this volume was drawn up and discarded before each sample was taken.)

The perfusion circuit was prepared in advance of need and was sterilized with ethylene oxide using an appropriate protocol of post-sterilization outgassing and aeration.



CRYOPROTECTIVE PERFUSION CIRCU

1) Cryoprotective Concentrate Reservoir
2) Recirculating Reservoir
3) Arterial Pump
4) Oxygenator (HPF Dialyzer)
5) Heat Exchanger (Sarns)
6) 40μ Filter (Pall)
7) Sample Port (Arterial)
8) Connector with port
9) Cannula (Arterial)
10) Cannula (Venous)
11) Sample Port (Venous)
12) Vent Line (Arterial)
13) Withdrawal (Ramp) Pump
14) Withdrawal Discard Line
15) Total Body Washout Discard Line
16) Cardiotomy Sucker
17) Cardiotomy Suction Pump
18) Magnetic Stirring Table

Cryoprotective Perfusion

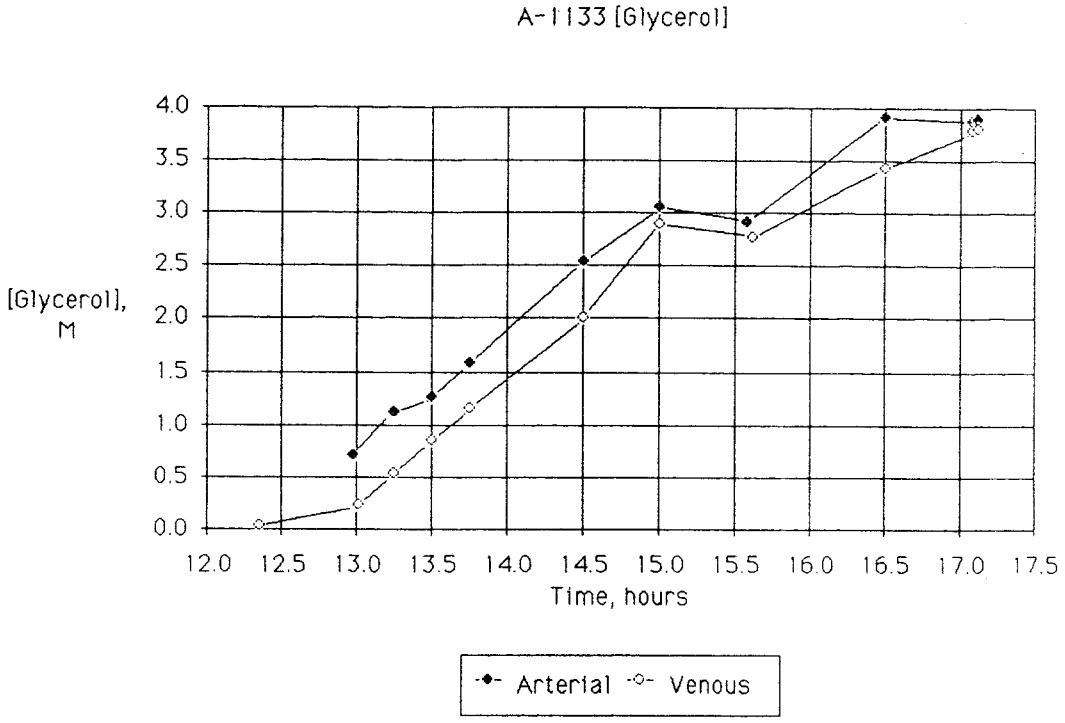
Open-circuit perfusion of base perfusate was begun at 15:44 at flow rate of 950 cc/min., an esophageal temperature of 1.8°C and an arterial temperature (perfusate) of 8.0°C. Venous pH was measured at 6.95 at 15:50. Perfusion flow rate was decreased to 400 cc/min. at 15:49, at which time mean arterial pressure (MAP) was 25 mmHg and the esophageal temperature was 2.7°C. At 15:58 arterial flow was increased to 500 cc/min. with a resultant increase in the MAP to 35 mmHG. Oxygen flow to the oxygenator was 3.0 liters throughout perfusion.

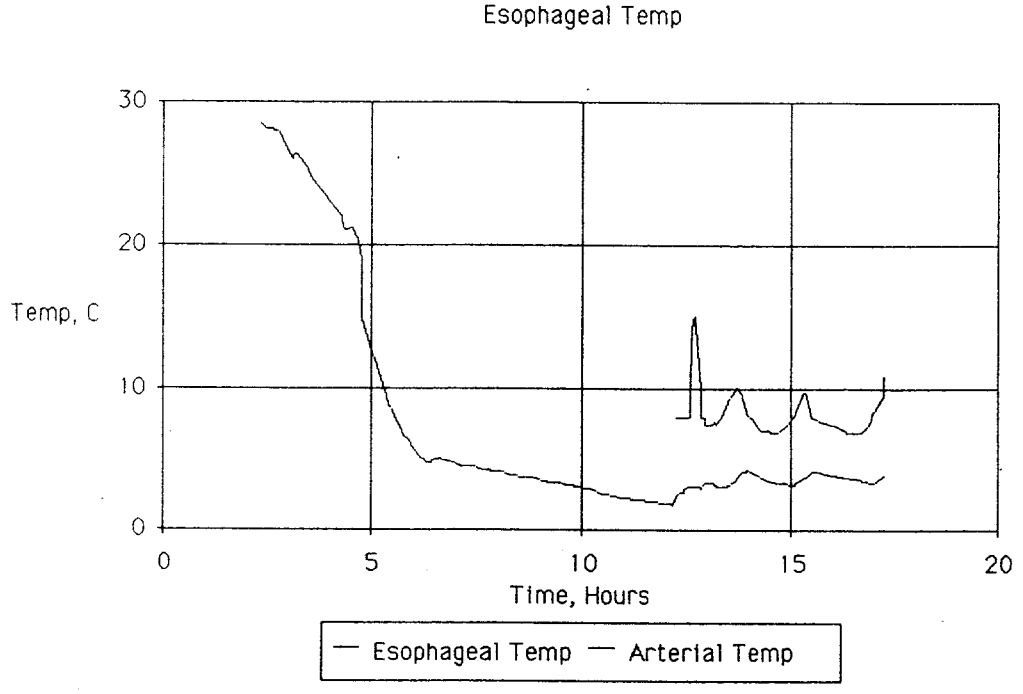
A total of 3600 cc of base perfusate was flushed through the patient open circuit after which approximately 2200 cc of 5% glycerol perfusate was added to the recirculating reservoir (while open circuit perfusion continued for 2 minutes at 500 cc/min.).

At 16:04 perfusion was interrupted and the level of perfusate in the recirculating reservoir was raised to 10.3 liters with 5% (w/v) glycerol perfusate. The concentrate reservoir was then filled with 10 liters of 50% (w/v) glycerol perfusate.

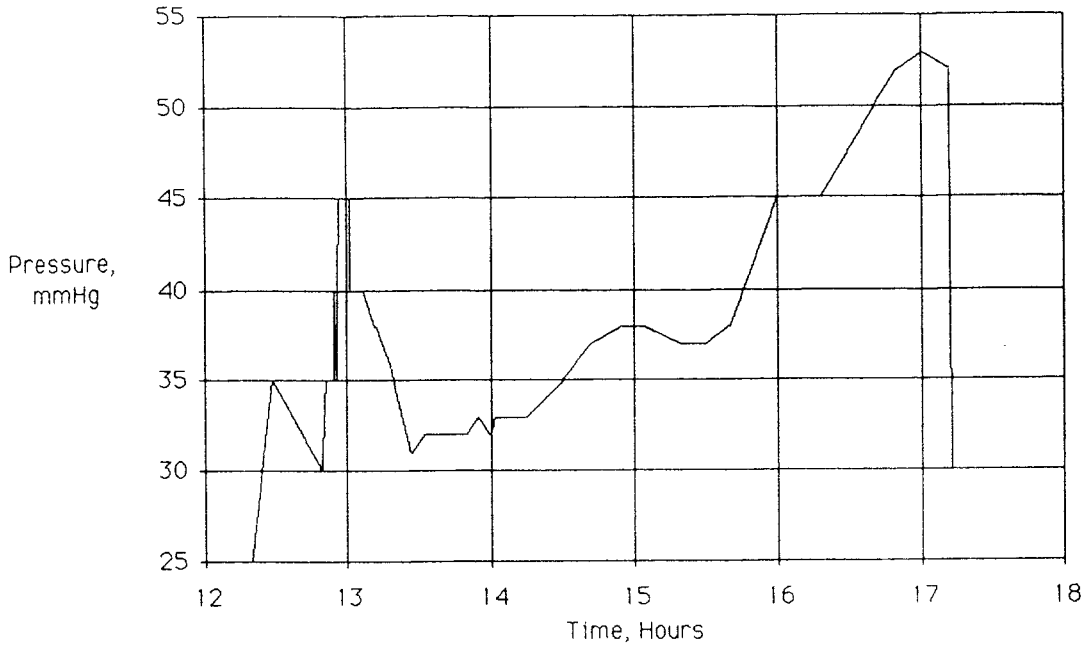
Perfusion was resumed at 16:19 with the start of the cryoprotective ramp. The

perfusion (arterial) flow rate was 500 cc/min., MAP was 35 mmHg, esophageal temperature was 3.4°C and arterial temperature was 8.0°C. The recirculating perfusate withdrawal/glycerol concentrate addition flow rate was set at 100 cc/min. to yield a 14 mM/min. rate of increase in arterial glycerol concentration. This resulted in an average arterial/venous difference in glycerol concentration of 400 to 500 mM over most of the first 2/3rds of the cryoprotective perfusion. The concentration of glycerol in the arterial and venous effluent, the arterial and esophageal temperatures, arterial pressure, and arterial flow rate are shown graphically below:

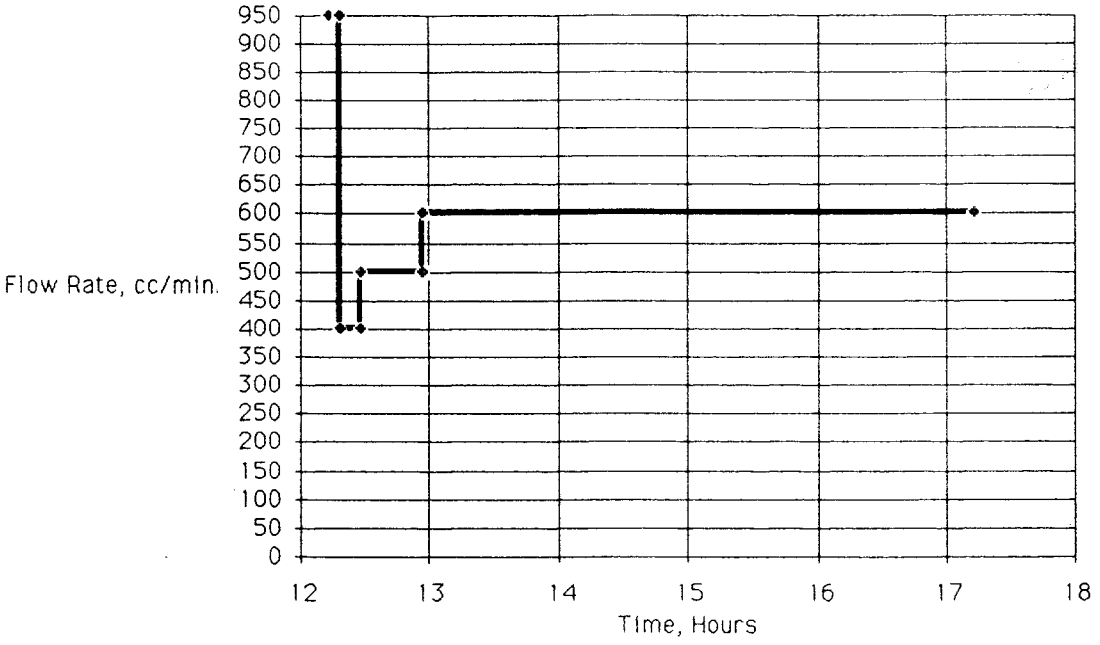




A-1133 Arterial Pressure

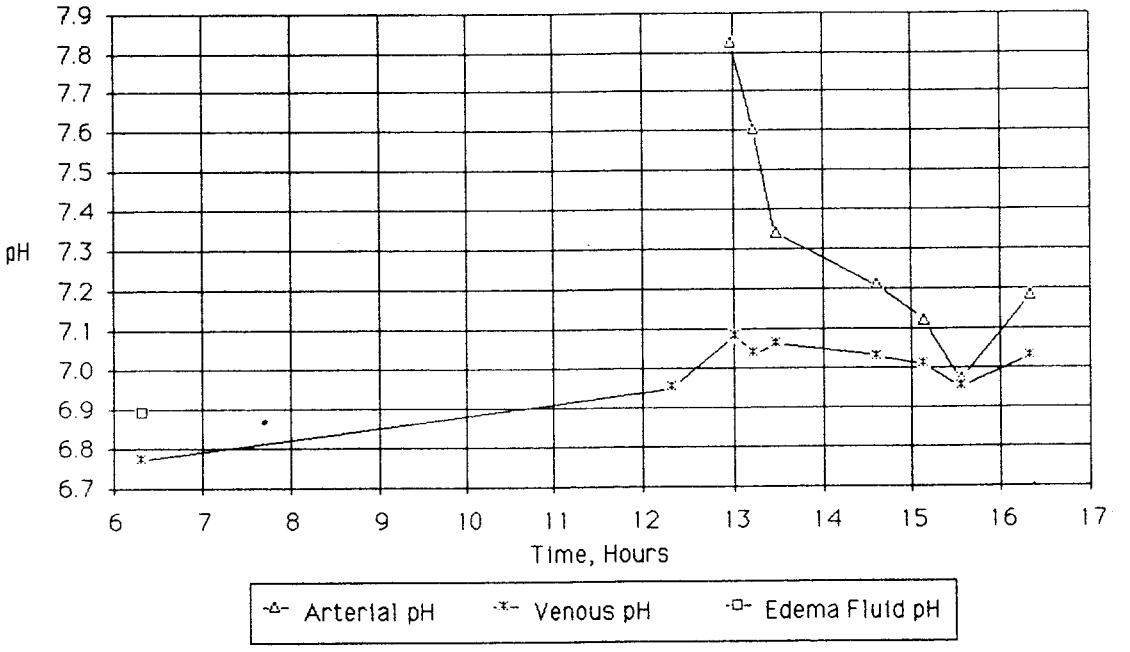


Flow Rate of Perfusate

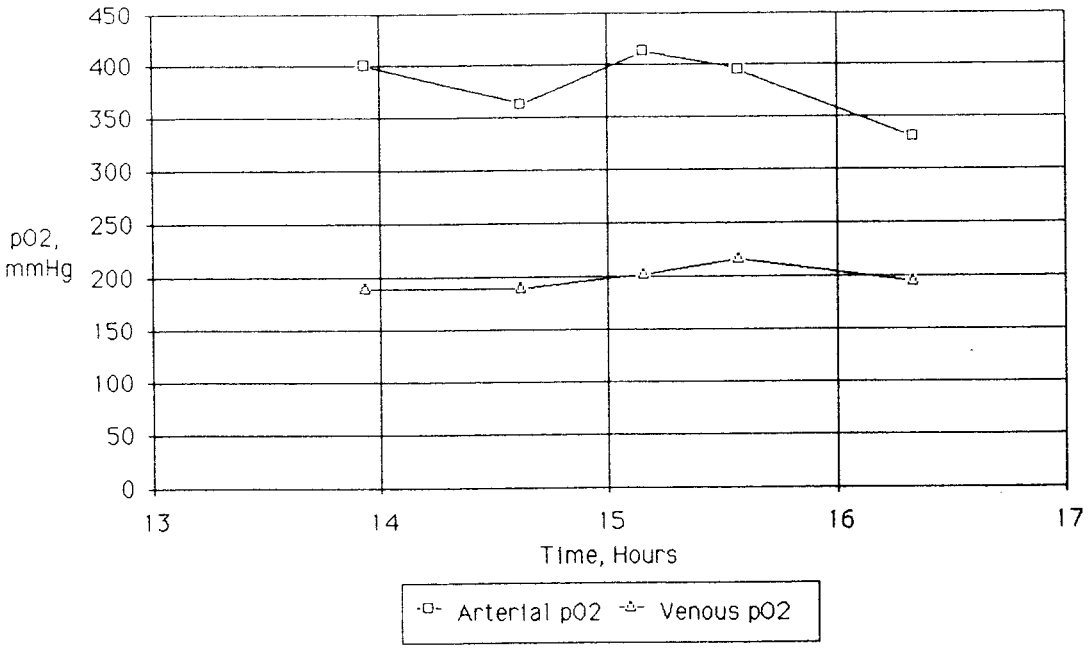


At 16:21 (two minutes after the start of the glycerol ramp) modest amounts of agglutinated red cells were observed streaming from the margins of the scalp wound, bone, and dura at the burr hole. By 16:29 the cortical surface was noted to be receding from the calvarium as observed through the burr-hole; apparently as a result of osmotic dehydration of the brain by glycerol. The usual mottling of the skin with areas of amber translucency due to cutaneous dehydration and alteration of the refractive index by glycerol was also noted at this time. Arterial pH measured at 16:29 was 7.82 and venous pH was 7.08.

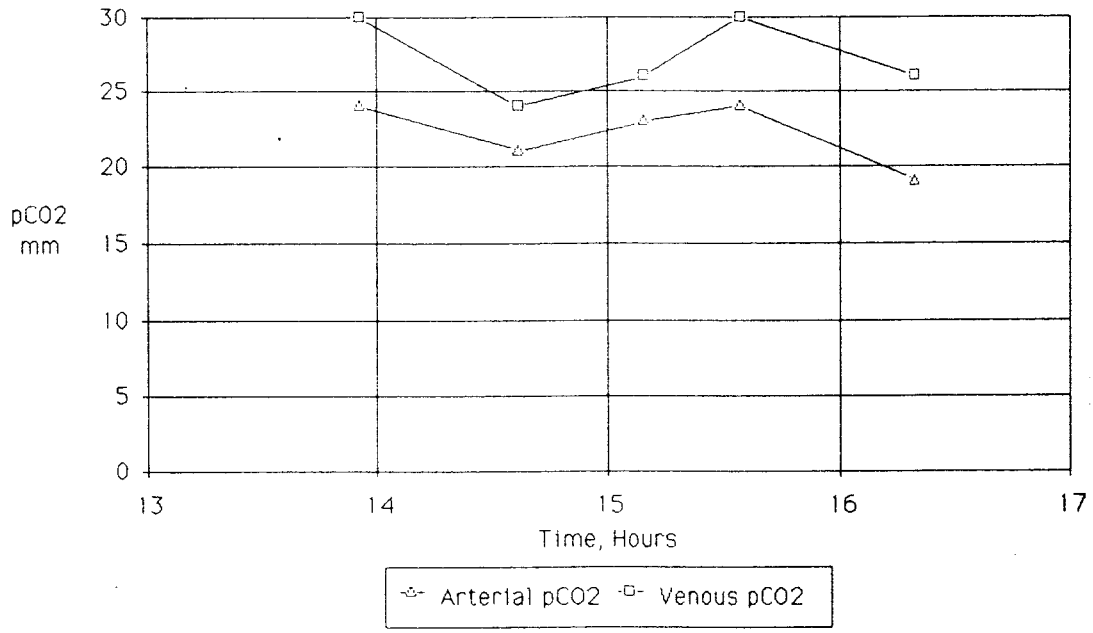
By 16:45 the brain had retracted approximately 10 mm from the burr-hole opening, arterial pH was 7.6, venous pH 7.4. Esophageal temperature at 16:48 was 3.1°C, arterial temperature 8.0°C, and MAP 36 mmHG. Modest drainage of clear perfusate from the burr hole was noted throughout cryoprotective perfusion; presumably as a result of leakage from the cut surfaces of scalp, bone, and dura. Arterial and venous pO_2 and CO_2 determinations were first made at 17:26. Arterial pO_2 was 401 mmHg and arterial CO_2 was 24 mmHg. Venous pO_2 was 190 mmHg and venous pCO_2 was 30 mmHg. Perfusion pH and gases were drawn again at 18:00 and were as follows: arterial pO_2 364 mmHg, arterial pCO_2 21 mmHg, arterial pH 7.21, venous pO_2 217, venous pCO_2 30, and venous pH 6.95. A final determination of arterial and venous pO_2 and pCO_2 was made at 19:50 and were as follows: arterial pO_2 331 mmHg, arterial pCO_2 19, arterial pH 7.18, venous pO_2 194, venous pCO_2 26, and venous pH 7.03. Perfusion pH, pO_2, and pCO_2 are presented graphically below.



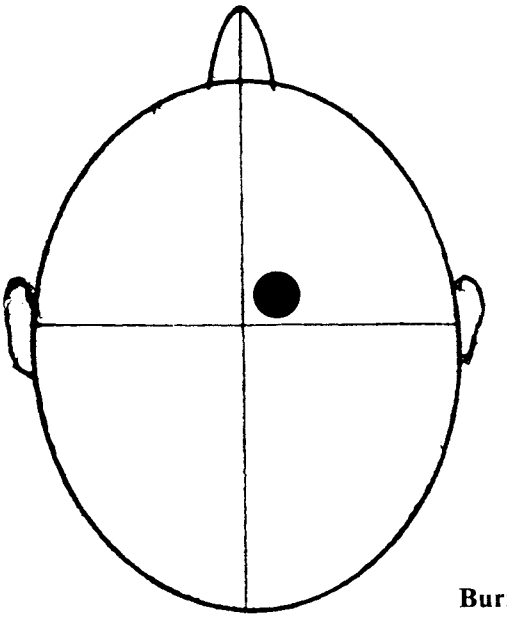
A-1133 pO2



A-1133 pCO2



At 20:20 the stainless steel disc of a YSI type 729 thermistor was threaded into the burr-hole and placed on the cortical surface. The burr hole was filled with bone wax and the scalp closed with surgical staples. The probe was anchored to the scalp with surgical staples and 3-O Tycron. Cerebral cortical temperature was measured at 4.2°C at 20:30. Temperature descent to -77°C was monitored with an esophageal probe in addition to the brain surface probe. This probe consisted of an Instrument Laboratories 53-20-507, "load type", 20 gauge, teflon-coated copper-constantan thermocouple that was used to replace the clinical TC probe used to monitor temperature during perfusion. This probe was anchored into place with suture and/or surgical staples.



Burr Hole Location

Cryoprotective perfusion was concluded at 20:43 at a flow rate of 600 cc/min., MAP of 52 mmHg, esophageal temperature of 3.9°C, and an arterial temperature of 9.5°C. Terminal glycerol concentration was 3.90 M in the final arterial sample and 3.80 M in the final venous sample. Glycerol concentration was determined both refractometrically with an American Optical model 10400 Goldberg hand-held refractometer and later osmometrically with a Precision Systems Osmette A osmometer.

Cephalic Isolation

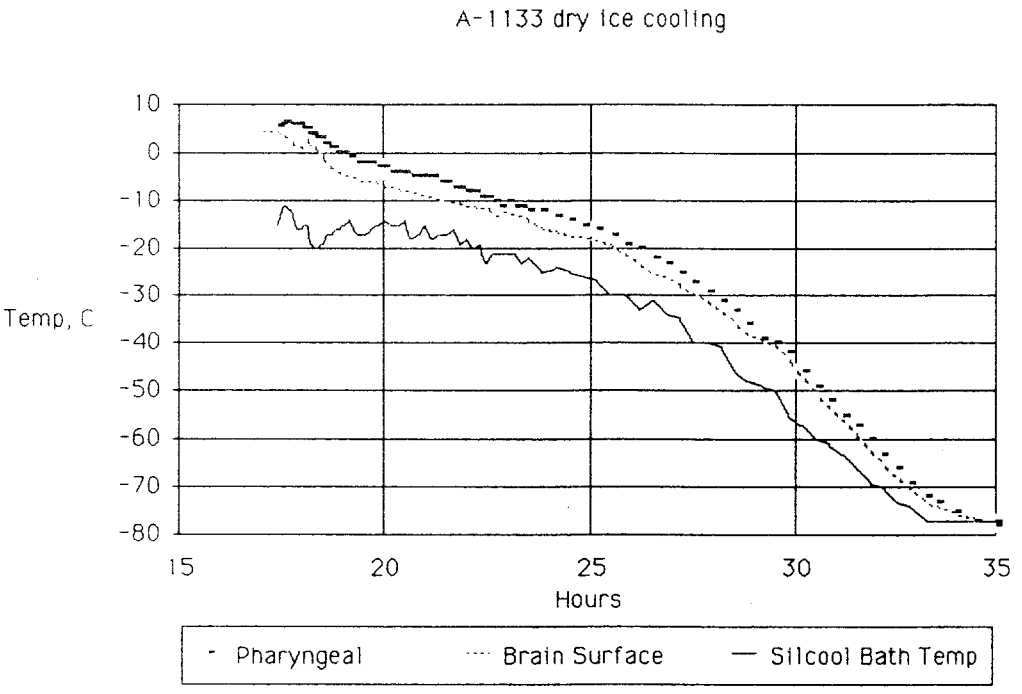
Surgery for cephalic isolation was begun at 20:45 with a circumferential skin incision made at the base of the neck and extended anteriorly and posteriorly to just below the margins of the clavicle. The skin was dissected free from the underlying connective tissue up to the level of the 5th cervical vertebrae to form skin flaps. The cervical musculature and other anatomical structures were then severed with a #10 scalpel blade down to the junction of the 5th and 6th cervical vertebrae. A Gigli saw was then passed under the vertebral column and the cut was made at approximately the level of the 5th cervical vertebrae, which freed the head from the body.

The cervical skin and musculature were observed to be dark in color, evenly stiff, and somewhat waxy in texture, consistent with uniform glycerolization.

Skin flaps were then closed over the stump of the neck using a skin stapler, after the edges of the flaps were first approximated using interrupted 2-0 Tycron suture. Cephalic isolation was completed at 20:54.

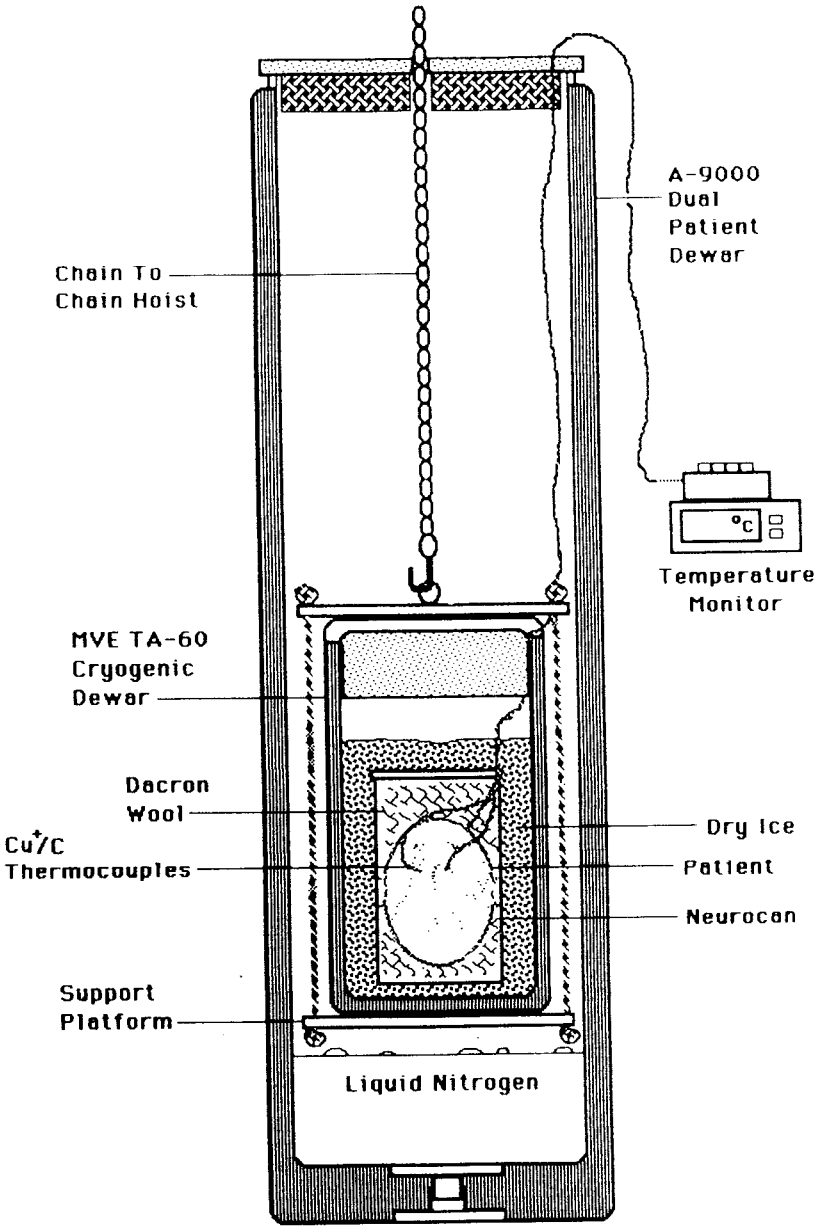
Cooling to Dry Ice Temperature

The patient (cephalon) was placed inside two 2 mil polyethylene plastic bags and lowered into a 15 liter bath of 5 centistoke polydimethylsiloxane oil (Silcool) which had been pre-cooled to -15°C. The first temperature readings taken at 21:14 were: esophageal 6.0°C, cerebral cortical surface 3.0°C, and bath -12.0°C. Cooling to -77°C was at a rate of approximately 4°C per hour with a bath to pharyngeal temperature differential of 15°C to 20°C and brain surface to pharyngeal temperature differential of 4°C to 5°C. Cooling to -77°C was complete by 13:00 on 6/9/87. The patient's dry ice cooling curve is presented below.



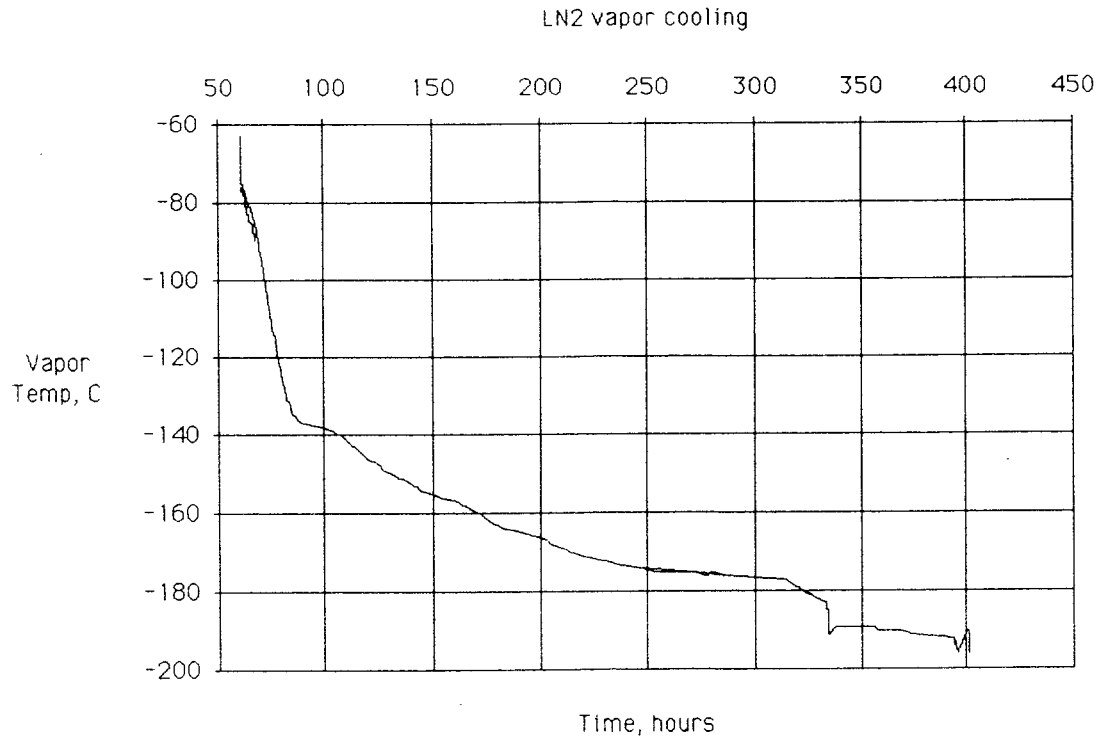
Cooling to -196°C

On 6/10/87 the patient was removed from the Silcool bath, the outer Silcool-soaked plastic bag was stripped off, and the patient was placed inside a polyester pillow case resting on a bed of Dacron wool at the bottom of a pre-cooled aluminum neurocan. An additional Instrument laboratory 53-20-507 load TC probe was threaded into the plastic bag containing the patient to monitor external temperature. This entire assembly had been pre-cooled by being nested inside an MVE TA-60 cryogenic dewar with the annulus between the neurocan and the dewar being filled with dry ice (see accompanying diagram). The pillow case was then closed with a white cotton shoe lace to which as affixed a stainless steel tag identifying the patient, and the lid of the TA-60 was closed with the TC probes externalized through the top.



Liquid Nitrogen Cooling Assembly

The TA-60 was then placed on a support platform of 3/4" plywood which could be lowered or raised on a chain hoist. The TA-60 was lowered into a modified MVE A-9000 dual patient cryogenic dewar to which 160 liters of liquid nitrogen had been added. The TA-60 was lowered until the bottom 2" was submerged in liquid nitrogen and a slotted plywood, fiberglass insulated lid put in place. Thermocouple probes were led out of the A-9000 and connected to a Omega 2165A thermocouple thermometer. The TA-60 was then raised or lowered as needed to obtain the desired rate of temperature descent. Cooling to -196°C was achieved at 03:30 on 6/24/87, at which time the patient was placed into long-term cryogenic storage by submersion in liquid nitrogen in an MVE A-8000 cryogenic dewar. The patient's liquid nitrogen cooling curve is presented below.



Laboratory Evaluations

Laboratory evaluations of samples taken during cryoprotective perfusion are presented in full in both graphic and tabular form as an addendum to this document. The following general observations are made:

All serum was noted to be markedly icteric.

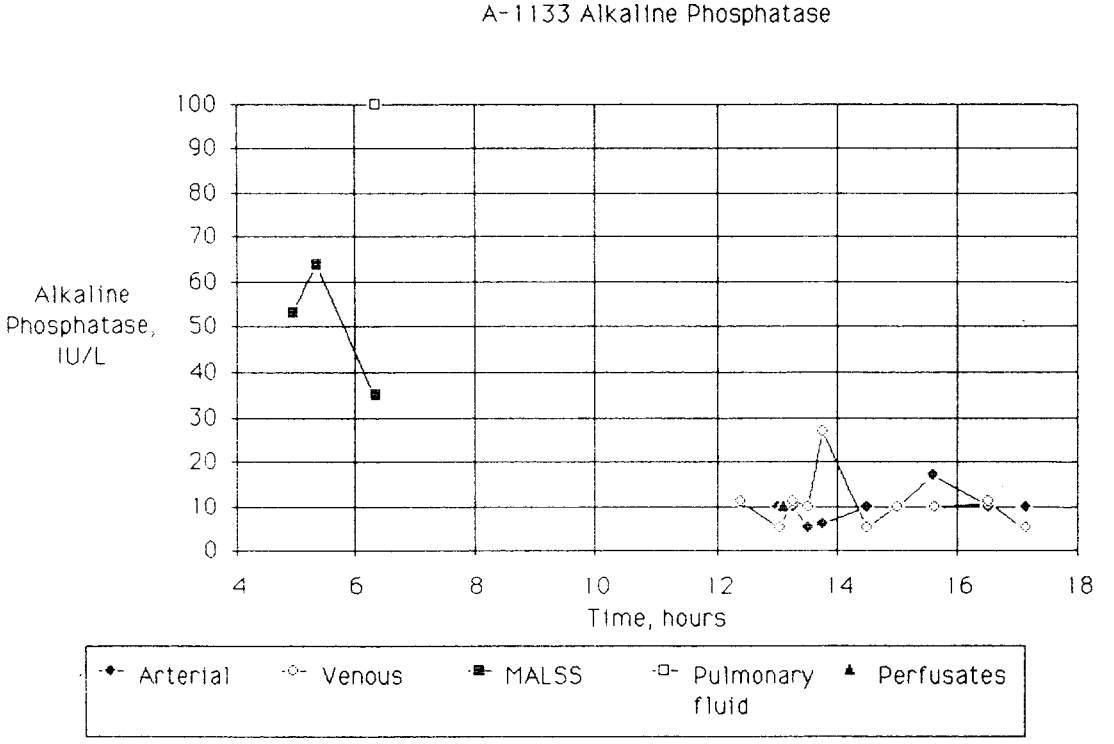
The initial samples drawn during MALSS support not surprisingly reveal elevated SGOT, SGPT, and CPK levels, presumably as a result of both the underlying disease process and the insult of prolonged shock and complete ischemia secondary to cardiac arrest. If hemodilution (3-fold) is factored into the evaluation, then it is likely that the LDH levels would also be elevated to a pathologic extent. As expected, tissue-specific enzyme levels decline with each "exchange" during MALSS support and recover during subsequent periods of recirculation.

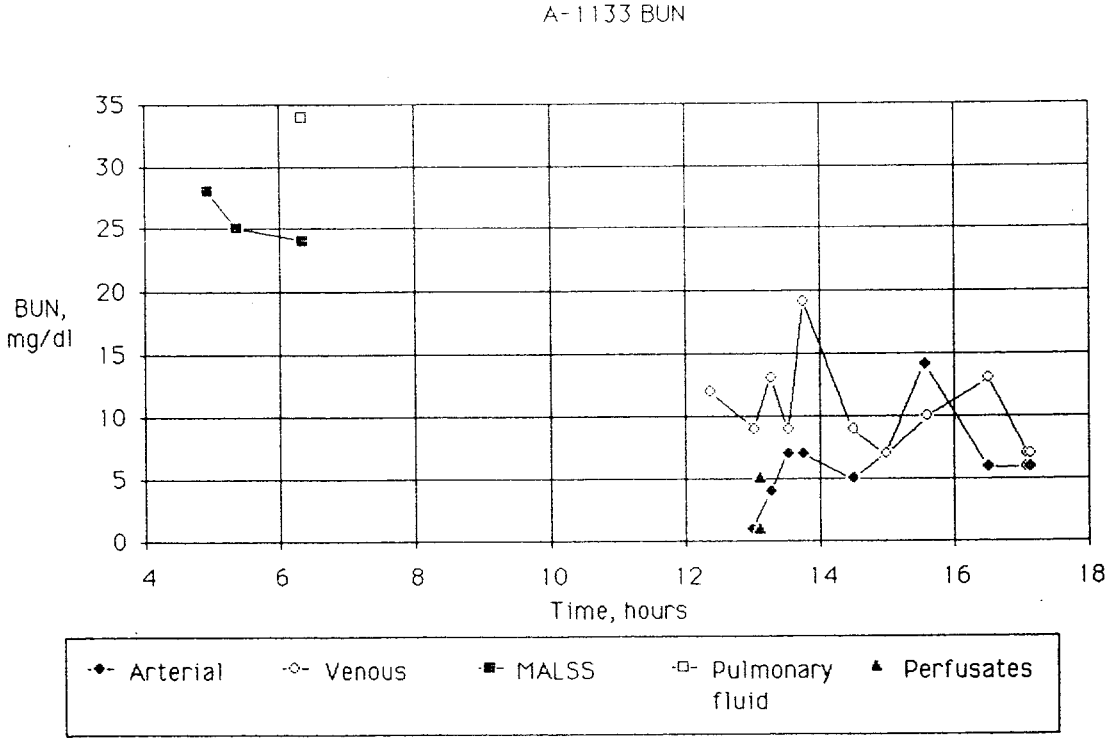
Similarly, at the start of cryoprotective perfusion enzyme levels in the venous effluent are higher probably reflecting leakage from the cells into the interstitial and intravascular fluid during the period of circulatory arrest.

As cryoprotective perfusion begins, enzyme and metabolite levels (such as bilirubin, BUN and creatinine) again decline reflecting further "washout" and dilution. CPK, LDH, and SGOT then remain elevated and continue to rise steadily; this despite the fact that the circulating volume of perfusate is being steadily diluted by the withdrawal of venous effluent and the addition of cryoprotective concentrate. It is notable that g-GT levels are essentially zero and remain so throughout cryoprotective perfusion apparently reflecting little if any leakage of this enzyme.

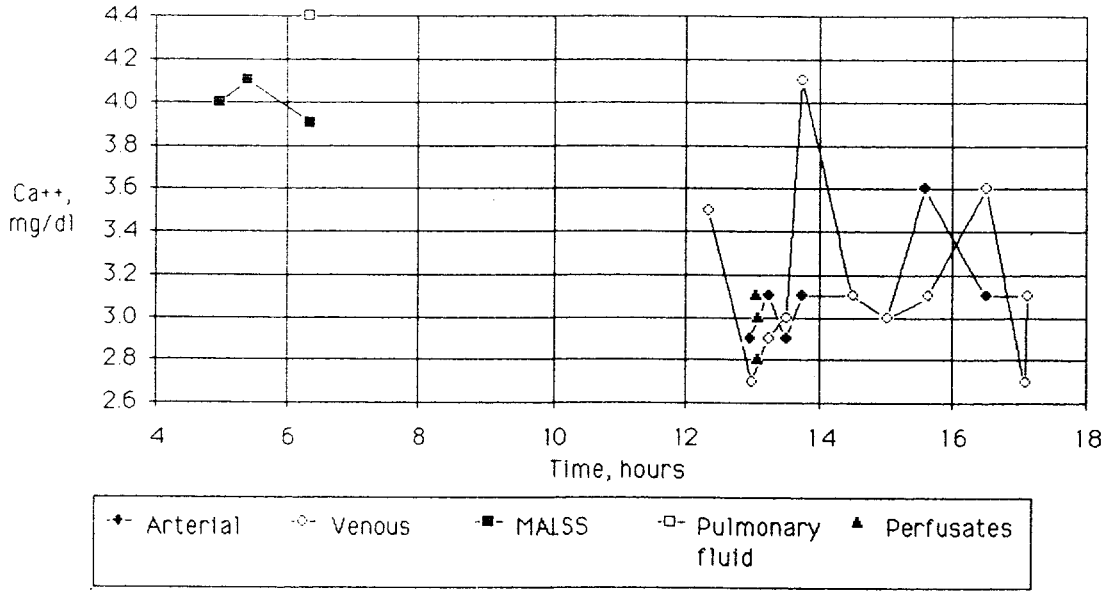
Evaluation of samples of both 5% (w/v) glycerol and 50% (w/v) glycerol perfusates

reveals baseline values well under what was observed during cryoprotective perfusion. Thus, it seems likely that the continued presence of, and increase in the concentration of, these enzymes is indicative of their on-going release from the tissues.

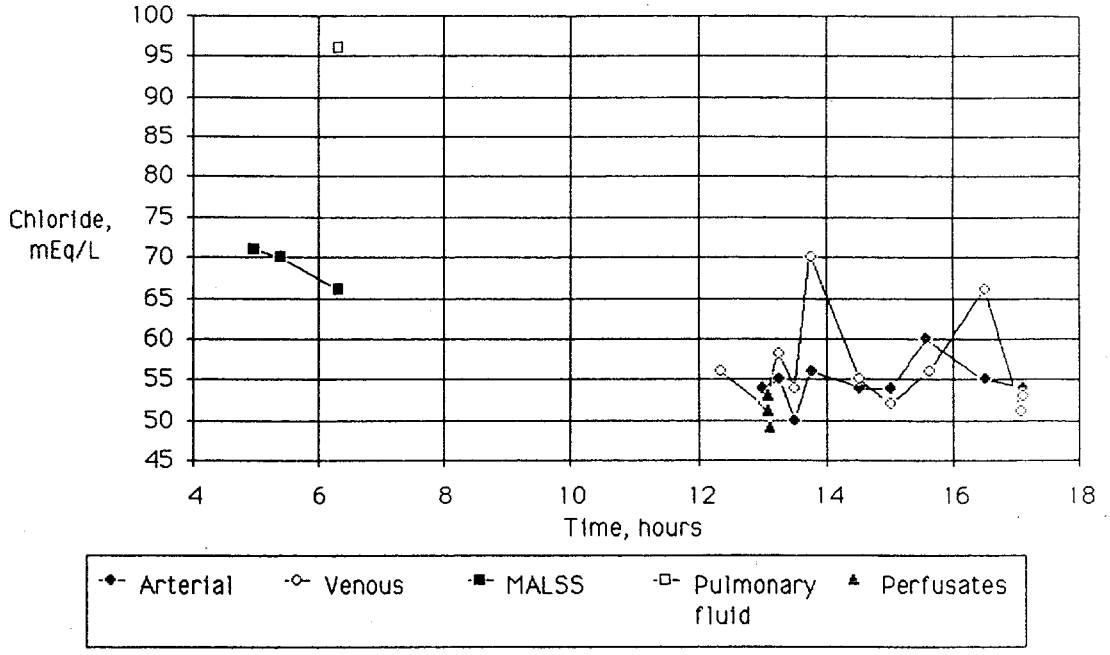




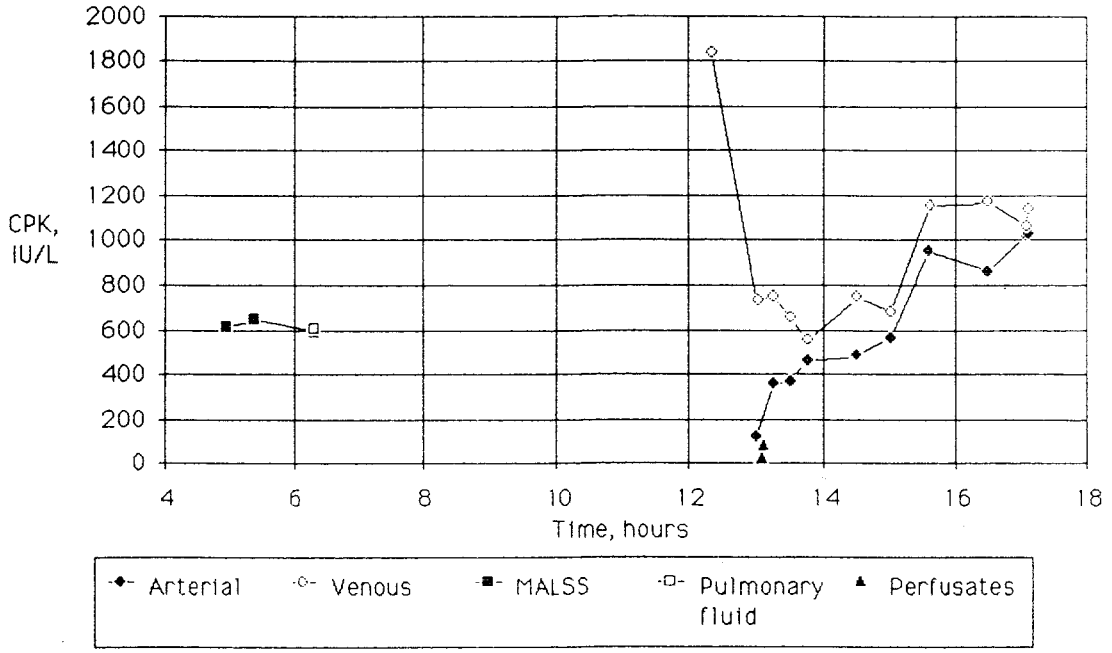
A-1133 Calcium++



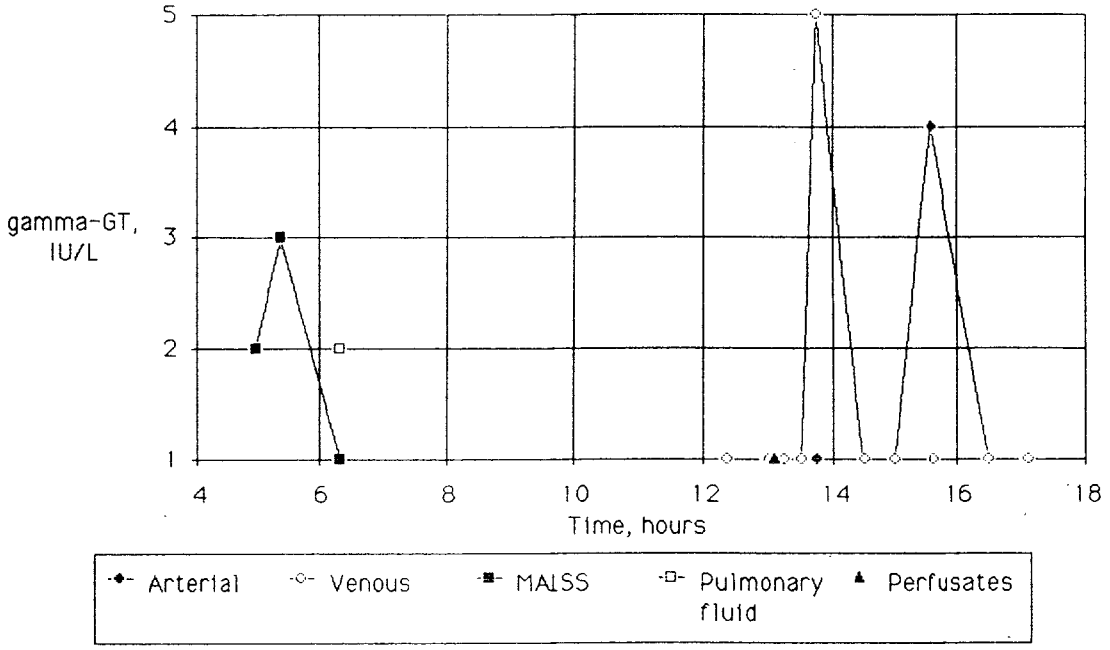
A-1133 Chloride-



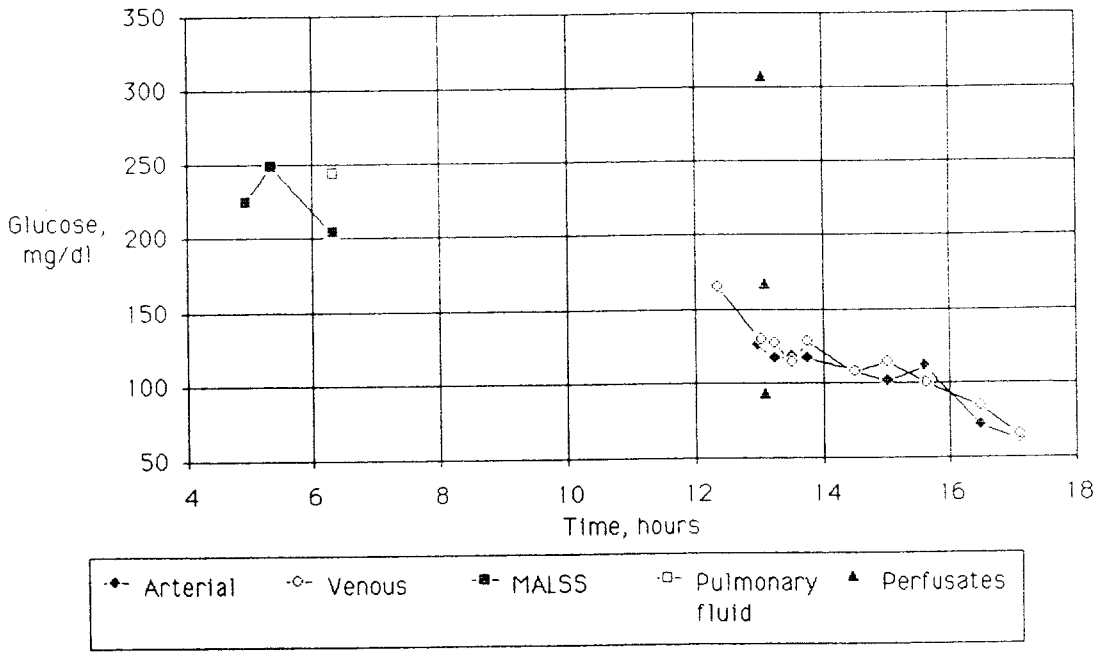
A-1133 Creatine Phosphokinase



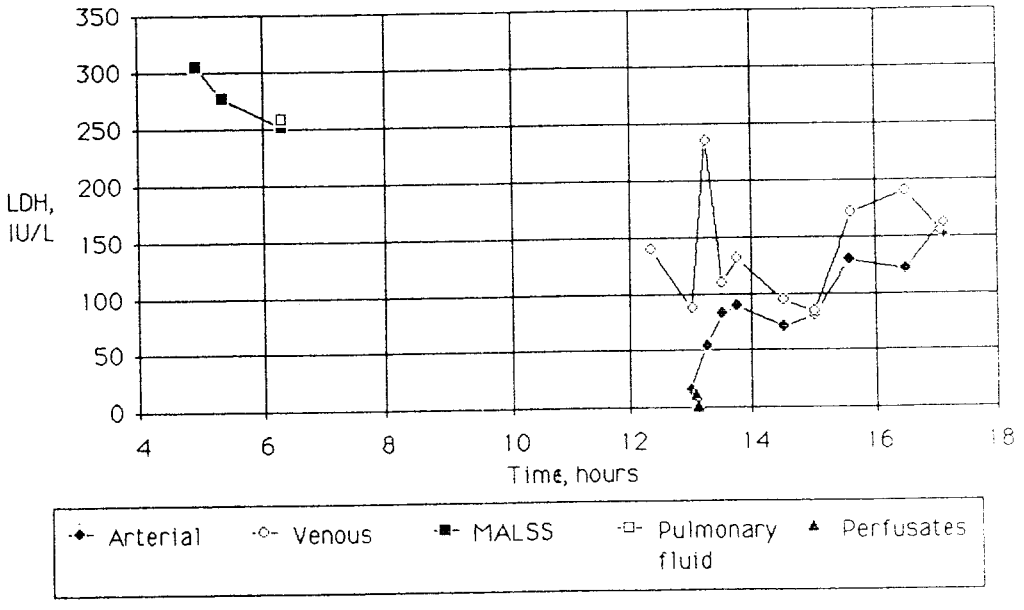
A-1133 gamma-GT



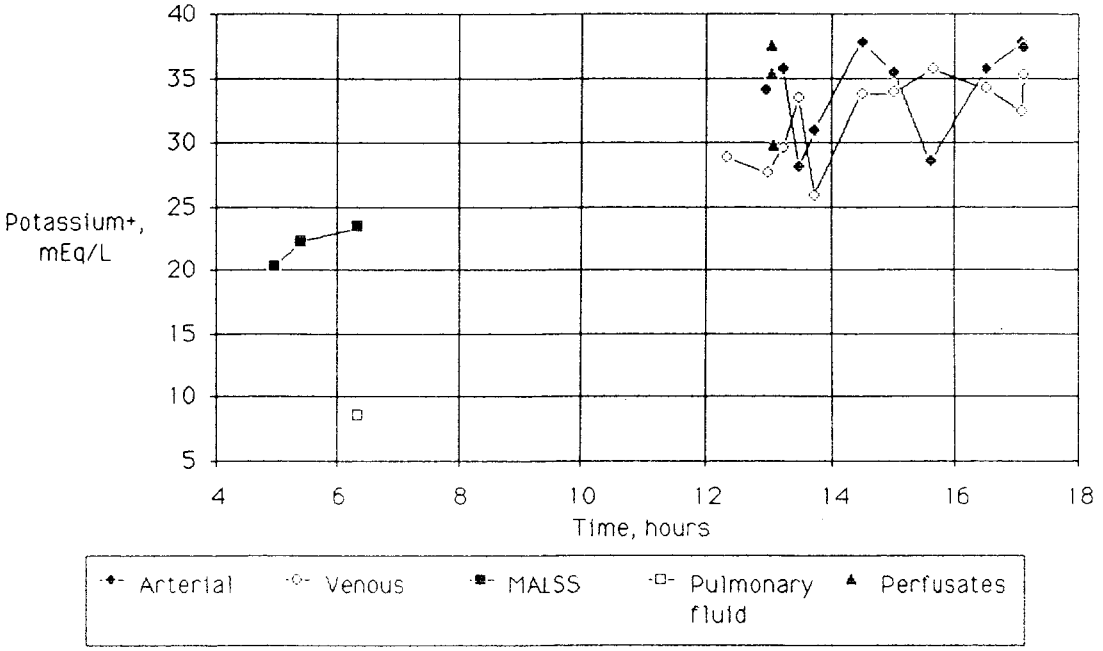
A-1133 Glucose



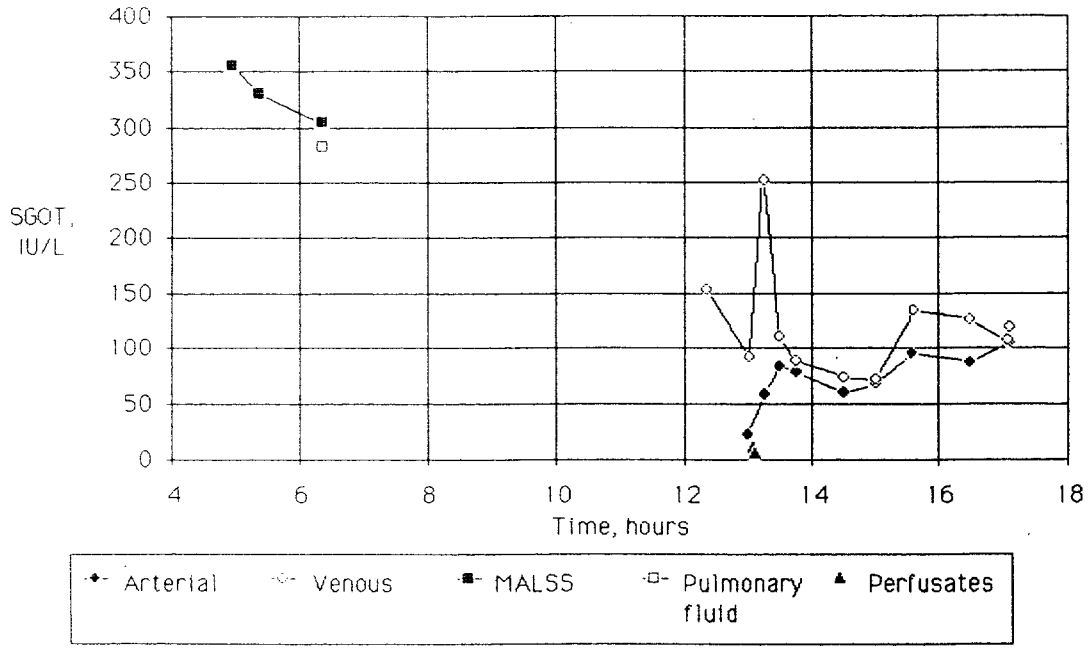
A-1133 Lactate dehydrogenase

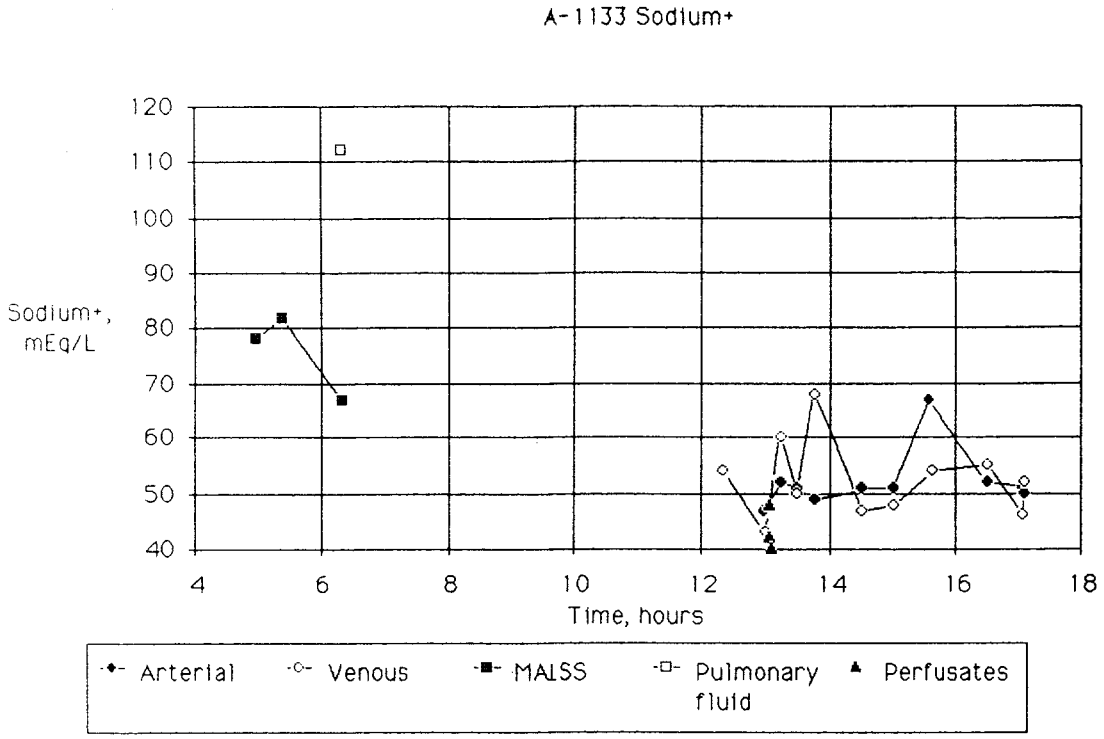


A-1133 Potassium+



A-1133 SGOT





Date Collected: 6/8/87. Time Collected: 16:36. Sample Source: Total Body Washout Solution (Base Perfusate).

SGOT	6 IU/l
SGPT	10 IU/l
Total Bilirubin	0.1 mg/dl
Direct Bilirubin	0.0 mg/dl
Indirect Bilirubin	0.1 mg/dl
BUN	5 mg/dl
Creatinine	0.2 mg/dl
Cholesterol	10 mg/dl
Alkaline Phosphatase	10 IU/l
Glucose	166 mg/dl
Phosphorus	1.0 mg/dl
Calcium	2.8 mg/dl
Total Protein	1.0 g/dl
Albumin	0.0 g/dl
Globulin	1.0 g/dl
Sodium	40 mEq/l
Potassium	29.7 mEq/l
Chloride	49 mEq/l
CO_2	7 mEq/l
Creatine Phosphokinase	75 IU/l
gamma-GT	1 IU/l
Uric Acid	0.0 mg/dl
Lactate Dehydrogenase	0 IU/l

Date Collected: 6/8/87. Time Collected: 0827. Sample Source: Venous Reservoir of MALSS.

SGOT	356 IU/l
SGPT	37 IU/l
Total Bilirubin	1.0 mg/dl
Direct Bilirubin	0.5 mg/dl
Indirect Bilirubin	0.5 mg/dl
BUN	28 mg/dl
Creatinine	1.8 mg/dl
Cholesterol	10 mg/dl
Alkaline Phosphatase	53 IU/l
Glucose	225 mg/dl
Phosphorus	8.5 mg/dl
Calcium	4.0 mg/dl
Total Protein	0.9 g/dl
Albumin	0.2 g/dl
Globulin	0.7 g/dl
Sodium	78 mEq/l
Potassium	20.4 mEq/l
Chloride	71 mEq/l
CO_2	2 mEq/l
Creatine Phosphokinase	610 IU/l
gamma-GT	2 IU/l
Uric Acid	3.0 mg/dl
Lactate Dehydrogenase	304 IU/l

Date Collected: 6/8/87. Time Collected: 08:52. Sample Source: Venous Reservoir of MALSS.

SGOT	330 IU/l
SGPT	34 IU/l
Total Bilirubin	1.2 mg/dl
Direct Bilirubin	0.5 mg/dl
Indirect Bilirubin	0.7 mg/dl
BUN	25 mg/dl
Creatinine	1.7 mg/dl
Cholesterol	10 mg/dl
Alkaline Phosphatase	64 IU/l
Glucose	249 mg/dl
Phosphorus	7.7 mg/dl
Calcium	4.1 mg/dl
Total Protein	1.0 g/dl
Albumin	0.2 g/dl
Globulin	0.8 g/dl
Sodium	82 mEq/l
Potassium	22.3 mEq/l
Chloride	70 mEq/l
CO_2	2 mEq/l
Creatine Phosphokinase	643 IU/l
gamma-GT	3 IU/l
Uric Acid	2.5 mg/dl
Lactate Dehydrogenase	277 IU/l

Date Collected: 6/8/87. Time Collected: 09:50. Sample Source: Venous Reservoir of MALSS.

SGOT	304 IU/l
SGPT	30 IU/l
Total Bilirubin	0.7 mg/dl
Direct Bilirubin	0.3 mg/dl
Indirect Bilirubin	0.4 mg/dl
BUN	24 mg/dl
Creatinine	1.5 mg/dl
Cholesterol	10.0 mg/dl
Alkaline Phosphatase	35 IU/l
Glucose	204 mg/dl
Phosphorus	6.5 mg/dl
Calcium	3.9 mg/dl
Total Protein	0.9 g/dl
Albumin	0.1 g/dl
Globulin	0.8 g/dl
Sodium	67 mEq/l
Potassium	23.4 mEq/l
Chloride	66 mEq/l
CO_2	3 mEq/l
Creatine Phosphokinase	586 IU/l
gamma-GT	1 IU/l
Uric Acid	2.3 mg/dl
Lactate Dehydrogenase	251 IU/l

Date Collected: 6/8/87. Time Collected: 09:50. Sample Source: Pulmonary Exudate.

SGOT	288 IU/l
SGPT	28 IU/l
Total Bilirubin	1.2 mg/dl
Direct Bilirubin	0.4 mg/dl
Indirect Bilirubin	0.8 mg/dl
BUN	34 mg/dl
Creatinine	2.4 mg/dl
Cholesterol	10 mg/dl
Alkaline Phosphatase	100 IU/l
Glucose	244 mg/dl
Phosphorus	8.4 mg/dl
Calcium	4.4 mg/dl
Total Protein	1.0 g/dl
Albumin	0.4 g/dl
Globulin	0.6 g/dl
Sodium	112 mEq/l
Potassium	8.6 mEq/l
Chloride	96 mEq/l
CO_2	8 mEq/l
Creatine Phosphokinase	602 IU/l
gamma-GT	2 IU/l
Uric Acid	4.2 mg/dl
Lactate Dehydrogenase	258 IU/l

Date Collected: 6/8/87. Time Collected:15:51. Sample Source: Venous Effluent CPA Perfusion.

SGOT	153 IU/l
SGPT	12 IU/l
Total Bilirubin	0.2 mg/dl
Direct Bilirubin	0.1 mg/dl
Indirect Bilirubin	0.1 mg/dl
BUN	12 mg/dl
Creatinine	0.8 mg/dl
Cholesterol	10 mg/dl
Alkaline Phosphatase	11 IU/l
Glucose	165 mg/dl
Phosphorus	3.7 mg/dl
Calcium	3.5 mg/dl
Total Protein	1.0 g/dl
Albumin	0.0 g/dl
Globulin	0.0 g/dl
Sodium	54.0 mEq/l
Potassium	28.8 mEq/l
Chloride	56 mEq/l
CO_2	6 mEq/l
Creatine Phosphokinase	1838 IU/l
gamma-GT	1 IU/l
Uric Acid	0.6 mg/dl
Lactate Dehydrogenase	139 IU/l

Date Collected: 6/8/87. Time Collected: 16:31 Sample Source: Venous Effluent CPA perfusion.

SGOT	92 IU/l
SGPT	10 IU/l
Total Bilirubin	0.1 mg/dl
Direct Bilirubin	0.0 mg/dl
Indirect Bilirubin	0.1 mg/dl
BUN	9 mg/dl
Creatinine	0.7 mg/dl
Cholesterol	10 mg/dl
Alkaline Phosphatase	5 IU/l
Glucose	129 mg/dl
Phosphorus	2.1 mg/dl
Calcium	2.7 mg/dl
Total Protein	1.0 g/dl
Albumin	0.0 g/dl
Globulin	1.0 g/dl
Sodium	43 mEq/l
Potassium	27.6 mEq/l
Chloride	52 mEq/l
CO_2	6 mEq/l
Creatine Phosphokinase	729 IU/l
gamma-GT	1 IU/l
Uric Acid	0.4 mg/dl
Lactate Dehydrogenase	87 IU/l

Date Collected: 6/8/87. Time Collected:16:45 Sample Source: Venous Effluent CPA Perfusion.

SGOT	252 IU/l
SGPT	28 IU/l
Total Bilirubin	0.2 mg/dl
Direct Bilirubin	0.1 mg/dl
Indirect Bilirubin	0.1 mg/dl
BUN	13 mg/dl
Creatinine	0.8 mg/dl
Cholesterol	10 mg/dl
Alkaline Phosphatase	11 IU/l
Glucose	127 mg/dl
Phosphorus	3.9 mg/dl
Calcium	2.9 mg/dl
Total Protein	0.9 g/dl
Albumin	0.0 g/dl
Globulin	0.9 g/dl
Sodium	60 mEq/l
Potassium	29.5 mEq/l
Chloride	58 mEq/l
CO_2	4 mEq/l
Creatine Phosphokinase	750 IU/l
gamma-GT	1 IU/l
Uric Acid	0.8 mg/dl
Lactate Dehydrogenase	234 IU/l

Date Collected: 6/8/87. Time Collected: 17:00 Sample Source: Venous Effluent CPA Perfusion.

SGOT	110 IU/l
SGPT	5 IU/l
Total Bilirubin	0.1 mg/dl
Direct Bilirubin	0.0 mg/dl
Indirect Bilirubin	0.1 mg/dl
BUN	9 mg/dl
Creatinine	0.6 mg/dl
Cholesterol	10 mg/dl
Alkaline Phosphatase	10 IU/l
Glucose	114 mg/dl
Phosphorus	2.1 mg/dl
Calcium	3.0 mg/dl
Total Protein	1.1 g/dl
Albumin	0.0 g/dl
Globulin	1.1 g/dl
Sodium	50 mEq/l
Potassium	33.5 mEq/l
Chloride	54 mEq/l
CO_2	5 mEq/l
Creatine Phosphokinase	659 IU/l
gamma-GT	1 IU/l
Uric Acid	0.2 mg/dl
Lactate Dehydrogenase	110 IU/l

Date Collected: 6/8/87. Time Collected: 17:15 Sample Source: Venous Effluent CPA Perfusion.

SGOT	88 IU/l
SGPT	5 IU/l
Total Bilirubin	0.2 mg/dl
Direct Bilirubin	0.1 mg/dl
Indirect Bilirubin	0.1 mg/dl
BUN	19 mg/dl
Creatinine	1.1 mg/dl
Cholesterol	14 mg/dl
Alkaline Phosphatase	27 IU/l
Glucose	128 mg/dl
Phosphorus	2.9 mg/dl
Calcium	4.1 mg/dl
Total Protein	1.7 g/dl
Albumin	0.3 g/dl
Globulin	1.4 g/dl
Sodium	68 mEq/l
Potassium	25.9 mEq/l
Chloride	70 mEq/l
CO_2	10 mEq/l
Creatine Phosphokinase	556 IU/l
gamma-GT	5 IU/l
Uric Acid	0.4 mg/dl
Lactate Dehydrogenase	131 IU/l

Date Collected: 6/8/87. Time Collected: 18:00 Sample Source: Venous Effluent CPA Perfusion.

SGOT	74 IU/l
SGPT	10 IU/l
Total Bilirubin	0.1 mg/dl
Direct Bilirubin	0.0 mg/dl
Indirect Bilirubin	0.1 mg/dl
BUN	9 mg/dl
Creatinine	0.5 mg/dl
Cholesterol	10 mg/dl
Alkaline Phosphatase	5 IU/l
Glucose	107 mg/dl
Phosphorus	1.7 mg/dl
Calcium	3.1 mg/dl
Total Protein	1.4 g/dl
Albumin	0.0 g/dl
Globulin	1.4 g/dl
Sodium	47 mEq/l
Potassium	33.8 mEq/l
Chloride	55 mEq/l
CO_2	6 mEq/l
Creatine Phosphokinase	747 IU/l
gamma-GT	1 IU/l
Uric Acid	0.3 mg/dl
Lactate Dehydrogenase	95 IU/l

Date Collected: 6/8/87. Time Collected: 18:30 Sample Source: Venous Effluent CPA Perfusion.

SGOT	72 IU/l
SGPT	7 IU/l
Total Bilirubin	0.1 mg/dl
Direct Bilirubin	0.1 mg/dl
Indirect Bilirubin	7 mg/dl
BUN	7 mg/dl
Creatinine	0.5 mg/dl
Cholesterol	10 mg/dl
Alkaline Phosphatase	10 IU/l
Glucose	114 mg/dl
Phosphorus	1.4 mg/dl
Calcium	3.0 mg/dl
Total Protein	1.3 g/dl
Albumin	0.0 g/dl
Globulin	1.3 g/dl
Sodium	48 mEq/l
Potassium	33.9 mEq/l
Chloride	52 mEq/l
CO_2	6 mEq/l
Creatine Phosphokinase	681 IU/l
gamma-GT	1 IU/l
Uric Acid	0.0 mg/dl
Lactate Dehydrogenase	85 IU/l

Date Collected: 6/8/87. Time Collected:19:07. Sample Source: Venous Effluent CPA Perfusion.

SGOT	134 IU/l
SGPT	12 IU/l
Total Bilirubin	0.1 mg/dl
Direct Bilirubin	0.0 mg/dl
Indirect Bilirubin	0.1 mg/dl
BUN	10 mg/dl
Creatinine	0.6 mg/dl
Cholesterol	10 mg/dl
Alkaline Phosphatase	10 IU/l
Glucose	100 mg/dl
Phosphorus	2.8 mg/dl
Calcium	3.1 mg/dl
Total Protein	1.3 g/dl
Albumin	0.0 g/dl
Globulin	1.3 g/dl
Sodium	54 mEq/l
Potassium	35.7 mEq/l
Chloride	56 mEq/l
CO_2	5 mEq/l
Creatine Phosphokinase	1160 IU/l
gamma-GT	1 IU/l
Uric Acid	0.3 mg/dl
Lactate Dehydrogenase	171 IU/l

Date Collected: 6/8/87. Time Collected: 19:07 Sample Source: Venous Effluent CPA Perfusion.

SGOT	134 IU/l
SGPT	12 IU/l
Total Bilirubin	0.1 mg/dl
Direct Bilirubin	0.0 mg/dl
Indirect Bilirubin	0.1 mg/dl
BUN	10 mg/dl
Creatinine	0.6 mg/dl
Cholesterol	10 mg/dl
Alkaline Phosphatase	10 IU/l
Glucose	100 mg/dl
Phosphorus	2.8 mg/dl
Calcium	3.1 mg/dl
Total Protein	1.3 g/dl
Albumin	0.0 g/dl
Globulin	1.3 g/dl
Sodium	54 mEq/l
Potassium	35.7 mEq/l
Chloride	56 mEq/l
CO_2	5 mEq/l
Creatine Phosphokinase	1160 IU/l
gamma-GT	1 IU/l
Uric Acid	0.3 mg/dl
Lactate Dehydrogenase	171 IU/l

Date Collected: 6/8/87. Time Collected: 20:00. Sample Source: Venous Effluent CPA Perfusion.

SGOT	126 IU/l
SGPT	5 IU/l
Total Bilirubin	0.1 mg/dl
Direct Bilirubin	0.0 mg/dl
Indirect Bilirubin	0.1 mg/dl
BUN	13 mg/dl
Creatinine	0.7 mg/dl
Cholesterol	3 mg/dl
Alkaline Phosphatase	11 IU/l
Glucose	84 mg/dl
Phosphorus	2.7 mg/dl
Calcium	3.6 mg/dl
Total Protein	1.7 g/dl
Albumin	0.1 g/dl
Globulin	1.6 g/dl
Sodium	55 mEq/l
Potassium	34.2 mEq/l
Chloride	66 mEq/l
CO_2	8 mEq/l
Creatine Phosphokinase	1173 IU/l
gamma-GT	1 IU/l
Uric Acid	0.5 mg/dl
Lactate Dehydrogenase	190 IU/l

Date Collected: 6/8/87. Time Collected: 20:35 Sample Source: Venous Effluent CPA Perfusion.

SGOT	107 IU/l
SGPT	11 IU/l
Total Bilirubin	0.1 mg/dl
Direct Bilirubin	0.0 mg/dl
Indirect Bilirubin	0.1 mg/dl
BUN	7 mg/dl
Creatinine	0.5 mg/dl
Cholesterol	10 mg/dl
Alkaline Phosphatase	5 IU/l
Glucose	66 mg/dl
Phosphorus	1.8 mg/dl
Calcium	2.7 mg/dl
Total Protein	1.5 g/dl
Albumin	0.0 g/dl
Globulin	1.5 g/dl
Sodium	46 mEq/l
Potassium	32.4 mEq/l
Chloride	51 mEq/l
CO_2	6 mEq/l
Creatine Phosphokinase	1066 IU/l
gamma-GT	1 IU/l
Uric Acid	0.4 mg/dl
Lactate Dehydrogenase	154 IU/l

Date Collected: 6/8/87. Time Collected: 20:37. Sample Source: Venous Effluent CPA Perfusion.

SGOT	120 IU/l
SGPT	15 IU/l
Total Bilirubin	0.1 mg/dl
Direct Bilirubin	0.0 mg/dl
Indirect Bilirubin	0.1 mg/dl
BUN	7 mg/dl
Creatinine	0.4 mg/dl
Cholesterol	10 mg/dl
Alkaline Phosphatase	5 IU/l
Glucose	65 mg/dl
Phosphorus	1.8 mg/dl
Calcium	3.1 mg/dl
Total Protein	1.5 g/dl
Albumin	0.0 g/dl
Globulin	1.5 g/dl
Sodium	52 mEq/l
Potassium	35.2 mEq/l
Chloride	53 mEq/l
CO_2	6 mEq/l
Creatine Phosphokinase	1142 IU/l
gamma-GT	1 IU/l
Uric Acid	0.1 mg/dl
Lactate Dehydrogenase	161 IU/l

Date Collected: 6/8/87. Time Collected: 13:08. Sample Source: 5% (w/v) glycerol perfusate.

SGOT	11 IU/l
SGPT	10 IU/l
Total Bilirubin	0.1 mg/dl
Direct Bilirubin	0.0 mg/dl
Indirect Bilirubin	0.1 mg/dl
BUN	1 mg/dl
Creatinine	0.2 mg/dl
Cholesterol	10 mg/dl
Alkaline Phosphatase	10 IU/l
Glucose	92 mg/dl
Phosphorus	1.0 mg/dl
Calcium	3.0 mg/dl
Total Protein	1.7 g/dl
Albumin	0.0 g/dl
Globulin	1.7 g/dl
Sodium	48 mEq/l
Potassium	37.4 mEq/l
Chloride	53 mEq/l
CO_2	7 mEq/l
Creatine Phosphokinase	14 IU/l
gamma-GT	1 IU/l
Uric Acid	0.0 mg/dl
Lactate Dehydrogenase	11 IU/l

Date Collected: 6/8/87. Time Collected: 16:34. Sample Source: 50% (w/v) glycerol perfusate.

SGOT	10 IU/l
SGPT	10 IU/l
Total Bilirubin	0.1 mg/dl
Direct Bilirubin	0.0 mg/dl
Indirect Bilirubin	0.1 mg/dl
BUN	5 mg/dl
Creatinine	0.2 mg/dl
Cholesterol	10 mg/dl
Alkaline Phosphatase	10 IU/l
Glucose	306 mg/dl
Phosphorus	1.0 mg/dl
Calcium	3.1 mg/dl
Total Protein	1.2 g/dl
Albumin	0.0 g/dl
Globulin	1.2 g/dl
Sodium	42 mEq/l
Potassium	35.2 mEq/l
Chloride	51 mEq/l
CO_2	7 mEq/l
Creatine Phosphokinase	19 IU/l
gamma-GT	1 IU/l
Uric Acid	0.0 mg/dl
Lactate Dehydrogenase	0 IU/l

Date Collected: 6/8/87. Time Collected: 16:29. Sample Source: Arterial Filter CPA Perfusion.

SGOT	23 IU/l
SGPT	10 IU/l
Total Bilirubin	0.1 mg/dl
Direct Bilirubin	0.0 mg/dl
Indirect Bilirubin	0.1 mg/dl
BUN	1 mg/dl
Creatinine	0.3 mg/dl
Cholesterol	10 mg/dl
Alkaline Phosphatase	10 IU/l
Glucose	126 mg/dl
Phosphorus	1.0 mg/dl
Calcium	2.9 mg/dl
Total Protein	1.2 g/dl
Albumin	0.0 g/dl
Globulin	1.2 g/dl
Sodium	47 mEq/l
Potassium	34.1 mEq/l
Chloride	54 mEq/l
CO_2	7 mEq/l
Creatine Phosphokinase	122 IU/l
gamma-GT	1 IU/l
Uric Acid	0.0 mg/dl
Lactate Dehydrogenase	16 IU/l

Date Collected: 6/8/87. Time Collected: 16:45. Sample Source: Arterial Filter CPA Perfusion.

SGOT	58 IU/l
SGPT	6 IU/l
Total Bilirubin	0.1 mg/dl
Direct Bilirubin	0.0 mg/dl
Indirect Bilirubin	0.1 mg/dl
BUN	4 mg/dl
Creatinine	0.3 mg/dl
Cholesterol	10 mg/dl
Alkaline Phosphatase	10 IU/l
Glucose	116 mg/dl
Phosphorus	1.6 mg/dl
Calcium	3.1 mg/dl
Total Protein	1.2 g/dl
Albumin	0.0 g/dl
Globulin	1.2 g/dl
Sodium	52 mEq/l
Potassium	35.7 mEq/l
Chloride	55 mEq/l
CO_2	7 mEq/l
Creatine Phosphokinase	357 IU/l
gamma-GT	1 IU/l
Uric Acid	0.0 mg/dl
Lactate Dehydrogenase	54 IU/l

Date Collected: 6/8/87. Time Collected: 17:00. Sample Source: Arterial Filter CPA Perfusion.

SGOT	83 IU/l
SGPT	5 IU/l
Total Bilirubin	0.1 mg/dl
Direct Bilirubin	0.0 mg/dl
Indirect Bilirubin	0.1 mg/dl
BUN	7 mg/dl
Creatinine	0.5 mg/dl
Cholesterol	10 mg/dl
Alkaline Phosphatase	5 IU/l
Glucose	118 mg/dl
Phosphorus	1.4 mg/dl
Calcium	2.9 mg/dl
Total Protein	1.1 g/dl
Albumin	0.0 g/dl
Globulin	1.1 g/dl
Sodium	51 mEq/l
Potassium	28.1 mEq/l
Chloride	50 mEq/l
CO_2	6 mEq/l
Creatine Phosphokinase	370 IU/l
gamma-GT	1 IU/l
Uric Acid	0.3 mg/dl
Lactate Dehydrogenase	82 IU/l

Date Collected: 6/8/87. Time Collected: 18:00. Sample Source: Arterial Line Filter CPA Perfusion.

SGOT	60 IU/l
SGPT	5 IU/l
Total Bilirubin	0.1 mg/dl
Direct Bilirubin	0.0 mg/dl
Indirect Bilirubin	0.1 mg/dl
BUN	5 mg/dl
Creatinine	0.5 mg/dl
Cholesterol	10.0 mg/dl
Alkaline Phosphatase	10 IU/l
Glucose	108 mg/dl
Phosphorus	1.0 mg/dl
Calcium	3.1 mg/dl
Total Protein	1.3 g/dl
Albumin	0.0 g/dl
Globulin	1.3 g/dl
Sodium	51 mEq/l
Potassium	37.8 mEq/l
Chloride	54 mEq/l
CO_2	6 mEq/l
Creatine Phosphokinase	484 IU/l
gamma-GT	1 IU/l
Uric Acid	0.0 mg/dl
Lactate Dehydrogenase	71 IU/l

Date Collected: 6/8/87. Time Collected: 18:30. Sample Source: Arterial Filter CPA Perfusion.

SGOT	68 IU/l
SGPT	6 IU/l
Total Bilirubin	0.1 mg/dl
Direct Bilirubin	0.0 mg/dl
Indirect Bilirubin	0.1 mg/dl
BUN	7 mg/dl
Creatinine	0.5 mg/dl
Cholesterol	10 mg/dl
Alkaline Phosphatase	10 IU/l
Glucose	101 mg/dl
Phosphorus	1.5 mg/dl
Calcium	3.0 mg/dl
Total Protein	1.4 g/dl
Albumin	0.0 g/dl
Globulin	1.4 g/dl
Sodium	51 mEq/l
Potassium	35.4 mEq/l
Chloride	54 mEq/l
CO_2	6 mEq/l
Creatine Phosphokinase	562 IU/l
gamma-GT	1 IU/l
Uric Acid	0.0 mg/dl
Lactate Dehydrogenase	81 IU/l

Date Collected: 6/8/87. Time Collected: 19:05. Sample Source: Arterial Filter CPA Perfusion.

SGOT	95 IU/l
SGPT	9 IU/l
Total Bilirubin	0.1 mg/dl
Direct Bilirubin	0.0 mg/dl
Indirect Bilirubin	0.1 mg/dl
BUN	14 mg/dl
Creatinine	0.8 mg/dl
Cholesterol	10 mg/dl
Alkaline Phosphatase	17 IU/l
Glucose	111 mg/dl
Phosphorus	2.8 mg/dl
Calcium	3.6 mg/dl
Total Protein	1.6 g/dl
Albumin	0.2 g/dl
Globulin	1.4 g/dl
Sodium	67 mEq/l
Potassium	28.5 mEq/l
Chloride	60 mEq/l
CO_2	9 mEq/l
Creatine Phosphokinase	949 IU/l
gamma-GT	4 IU/l
Uric Acid	1.4 mg/dl
Lactate Dehydrogenase	130 IU/l

Date Collected: 6/8/87. Time Collected: 20:00. Sample Source: Arterial Filter CPA Perfusion.

SGOT	87 IU/l
SGPT	5 IU/l
Total Bilirubin	0.1 mg/dl
Direct Bilirubin	0.0 mg/dl
Indirect Bilirubin	0.1 mg/dl
BUN	6 mg/dl
Creatinine	0.4 mg/dl
Cholesterol	10 mg/dl
Alkaline Phosphatase	10 IU/l
Glucose	72 mg/dl
Phosphorus	1.6 mg/dl
Calcium	3.1 mg/dl
Total Protein	1.5 g/dl
Albumin	0.0 g/dl
Globulin	1.5 g/dl
Sodium	52 mEq/l
Potassium	35.7 mEq/l
Chloride	55 mEq/l
CO_2	7 mEq/l
Creatine Phosphokinase	857 IU/l
gamma-GT	1 IU/l
Uric Acid	0.1 mg/dl
Lactate Dehydrogenase	121 IU/l

Date Collected: 6/8/87. Time Collected: 20:35. Sample Source: Arterial Filter CPA Perfusion.

SGOT	105 IU/l
SGPT	12 IU/l
Total Bilirubin	0.1 mg/dl
Direct Bilirubin	0.0 mg/dl
Indirect Bilirubin	0.1 mg/dl
BUN	6 mg/dl
Creatinine	0.4 mg/dl
Cholesterol	10 mg/dl
Alkaline Phosphatase	10 IU/l
Glucose	63 mg/dl
Phosphorus	1.7 mg/dl
Calcium	3.1 mg/dl
Total Protein	1.5 g/dl
Albumin	0.0 g/dl
Globulin	1.5 g/dl
Sodium	51 mEq/l
Potassium	37.8 mEq/l
Chloride	54 mEq/l
CO_2	6 mEq/l
Creatine Phosphokinase	1019 IU/l
gamma-GT	1 IU/l
Uric Acid	0.0 mg/dl
Lactate Dehydrogenase	160 IU/l

Date Collected: 6/8/87. Time Collected: 20:37. Sample Source: Arterial Filter CPA Perfusion.

SGOT	105 IU/l
SGPT	13 IU/l
Total Bilirubin	0.1 mg/dl
Direct Bilirubin	0.0 mg/dl
Indirect Bilirubin	0.1 mg/dl
BUN	6 mg/dl
Creatinine	0.4 mg/dl
Cholesterol	10 mg/dl
Alkaline Phosphatase	10 IU/l
Glucose	63 mg/dl
Phosphorus	1.7 mg/dl
Calcium	3.1 mg/dl
Total Protein	1.5 g/dl
Albumin	0.0 g/dl
Globulin	1.5 g/dl
Sodium	50 mEq/l
Potassium	37.7 mEq/l
Chloride	54 mEq/l
CO_2	6 mEq/l
Creatine Phosphokinase	1029 IU/l
gamma-GT	1 IU/l
Uric Acid	0.0 mg/dl
Lactate Dehydrogenase	151 IU/l

Date Collected: 6/8/87. Time Collected: 18:30. Sample Source: Arterial Filter CPA Perfusion.

SGOT	IU/l
SGPT	IU/l
Total Bilirubin	mg/dl
Direct Bilirubin	mg/dl
Indirect Bilirubin	mg/dl
BUN	mg/dl
Creatinine	mg/dl
Cholesterol	mg/dl
Alkaline Phosphatase	IU/l
Glucose	mg/dl
Phosphorus	mg/dl
Calcium	mg/dl
Total Protein	g/dl
Albumin	g/dl
Globulin	g/dl
Sodium	mEq/l
Potassium	mEq/l
Chloride	mEq/l
CO_2	mEq/l
Creatine Phosphokinase	IU/l
gamma-GT	IU/l
Uric Acid	mg/dl
Lactate Dehydrogenase	IU/l