



P-26

Case & Quality Reports 2025

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Introduction

The SST team consisted of five members with the following roles: lead surgeon, surgical assistant, perfusionist, support, and remote support. Initially, two team members arrived at the location and remained on standby for one day prior to the patient's legal pronouncement of death.

The patient went into cardiopulmonary arrest in the hospital ward, and the legal pronouncement process was initiated by the attending doctor. Legal pronouncement was completed approximately 135 minutes after cardiopulmonary arrest and the patient was transferred to the ambulance by the standby team.

The following stabilization procedures were performed by two team members and one remote support. Please note that several procedures were performed in parallel:

- Thermocouple insertion into each ear.
- Rectal temperature probe insertion (with occlusion device).
- Chest compression with LUCAS 2 device.
- 60 kg of ice and approximately 80 L of water placed into ice bath.
- i-Gel placed and ventilation started.
- Burr hole drilled for access.

The following medication was administered via two bone marrow needles:

Medication	Dosage
Urokinase	300,000 IE
Heparin	50,000 IE
Sodium Citrate	100 g
Lidocaine + MgCl	160 mg + 4 mg
TRIS	250 ml
Minocycline	200 mg
Vasopressin	0.4 mg
Insulin	900 IE

SCCD water flow around the body, through the cooling mask and nasopharyngeal cooling started.

After stabilization, the third and fourth on-site team members arrived, and the team began preparing for surgery and perfusion:

- Perfusion system primed.
- Median sternotomy for cardiac surgical access.
- Aorta cannulated and perfusion initiated.
- Atrial incision, cardiomy suction.
- 21L of MHP-2 washout solution was initially perfused.
- Cryoprotectant perfusion with gradual increasing concentrations as shown in the table below:

Concentration	Volume
MHP-2	21 L
5% w/v	21 L
10% w/v	21 L
30% w/v	21 L
70% w/v	84 L

Perfusion was conducted in an open-circuit configuration. At the end of perfusion, the circuit was closed for 15 minutes with 70% w/v. During perfusion, two brain tissue samples were obtained for electron microscopy analysis with patient consent.

The patient was then placed on dry ice and transported to the European Biostasis Foundation for cooldown. Upon arrival at the facility, the patient was received and prepared for cooldown to cryogenic temperatures. Cooldown and CT analysis proceeded as follows:

- CT scan performed at -80°C .
- Rapid cooldown to temperatures above the glass transition temperature.
- Slow, gradual cooldown from above the glass transition temperature to cryogenic temperatures.
- CT scan performed at -196°C .

Following completion of cooldown and CT analysis, the patient was carefully transferred in a storage pod to a long-term storage dewar.

Cryoprotection Data

Temperature

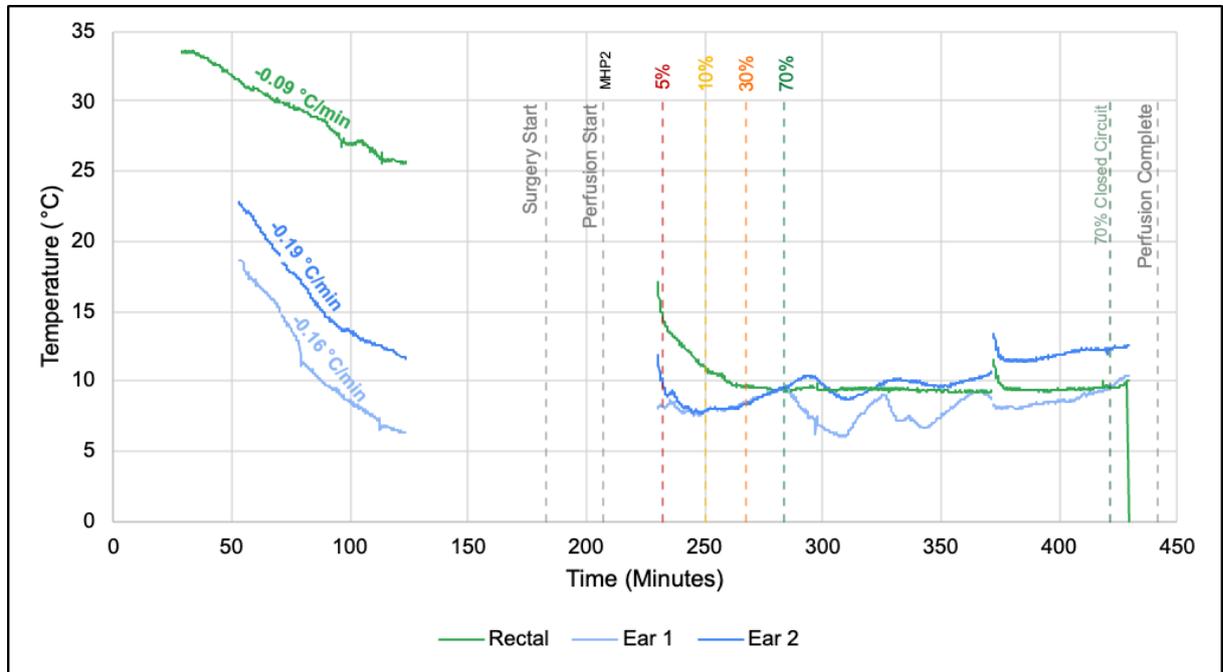


Figure 1. Patient temperature during stabilization, surgery, and perfusion, with a timeline highlighting the perfusates used. Initial cooling rates recorded by each probe are shown.

Refractive Index

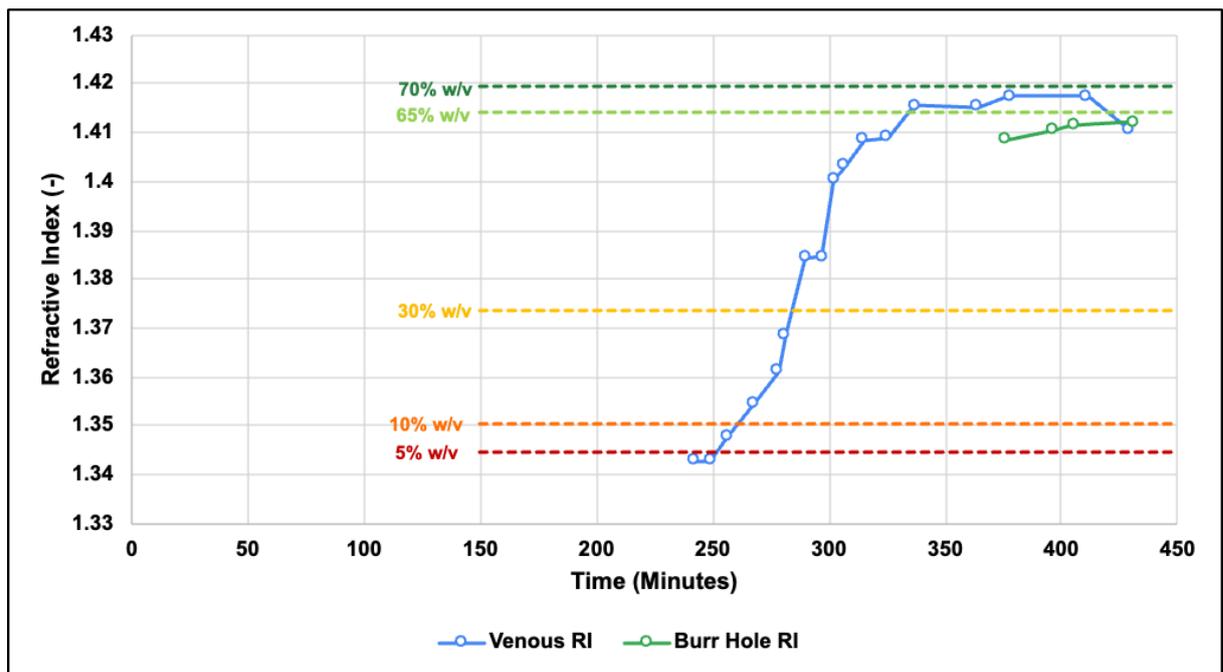


Figure 2. Patient's refractive index during surgery and perfusion.

Pressure

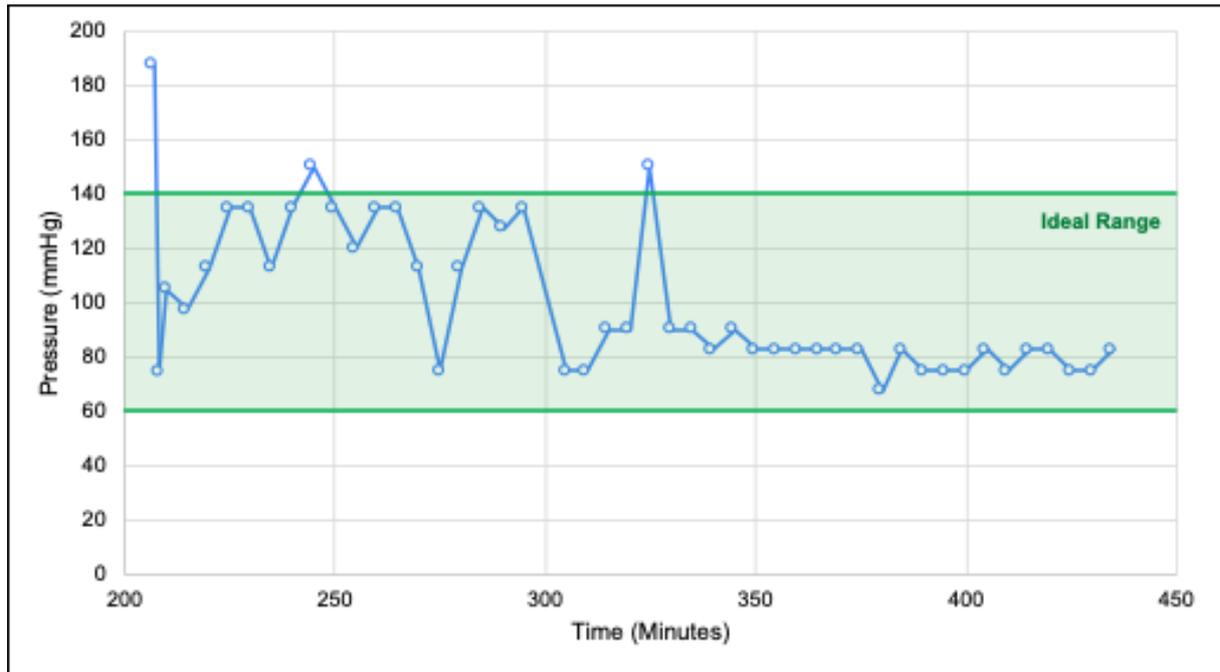


Figure 3. Perfusion pressure over time, with the ideal pressure range highlighted.

Cooldown

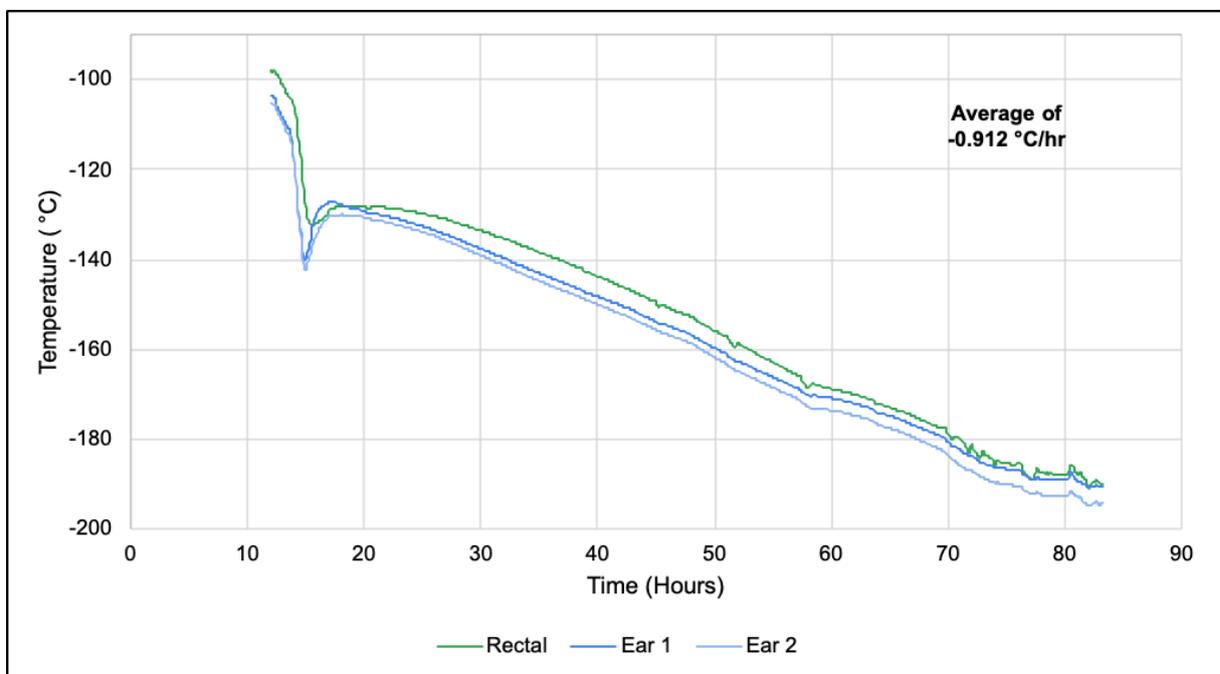


Figure 4. Patient cooldown to -196°C.

S-MIX

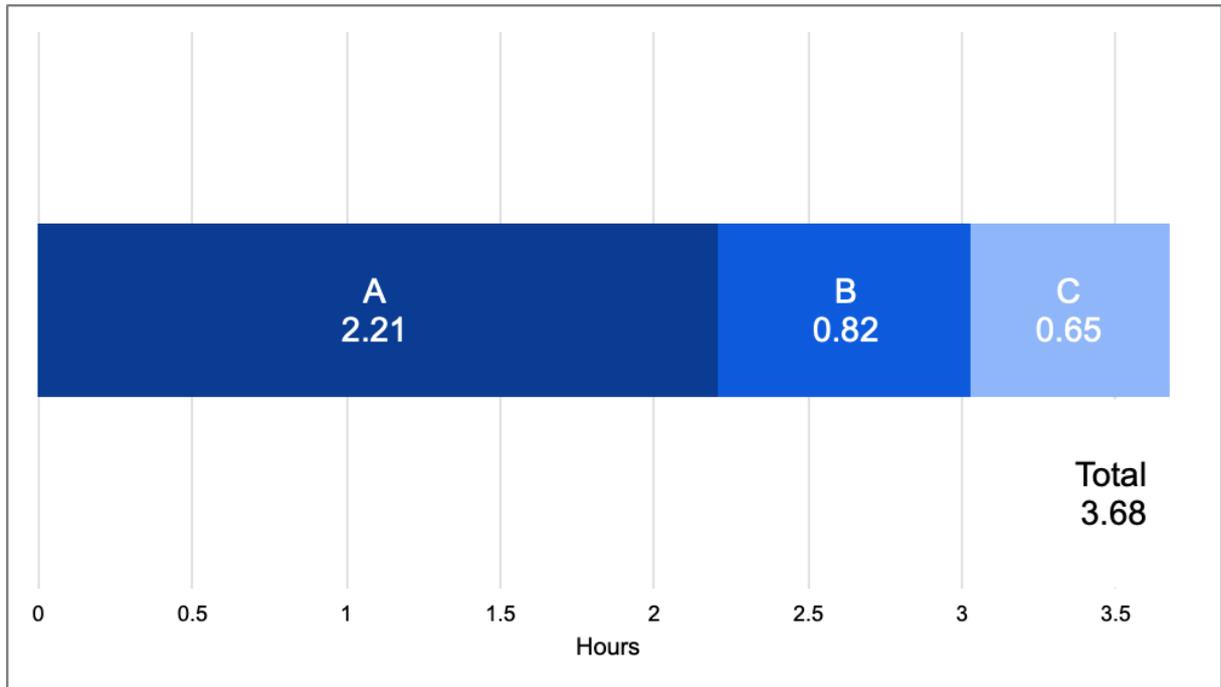


Figure 5. S-MIX calculation.

Segment A: Time of death until start of chest compressions – 2.21

Segment B: Start of chest compressions until start of perfusion – 0.82

Segment C: Start of perfusion until end of perfusion – 0.65

CT Scan Analysis

Overview

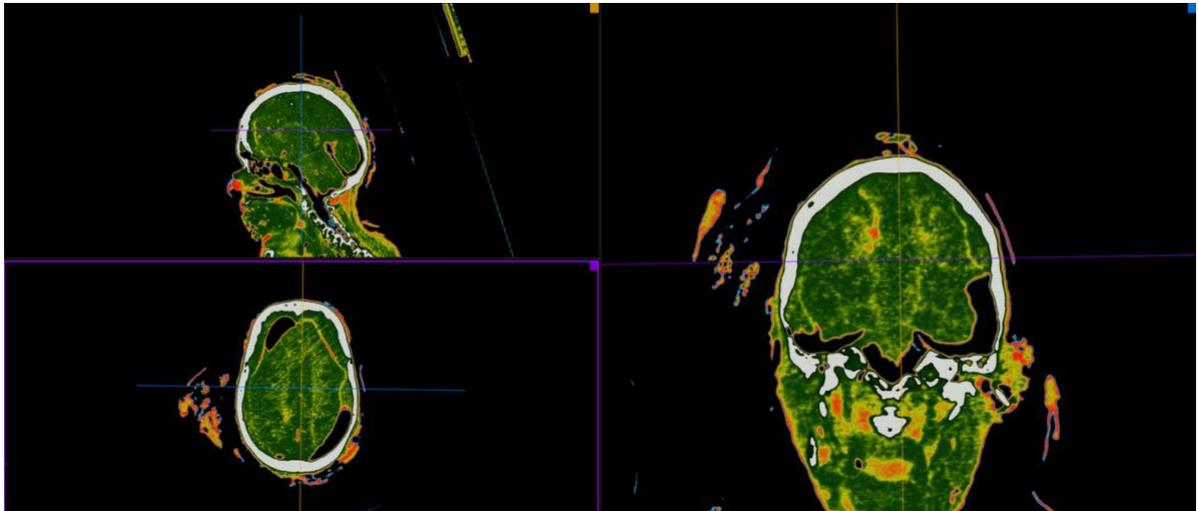


Figure 6. 3-panel projection (pseudo-color).

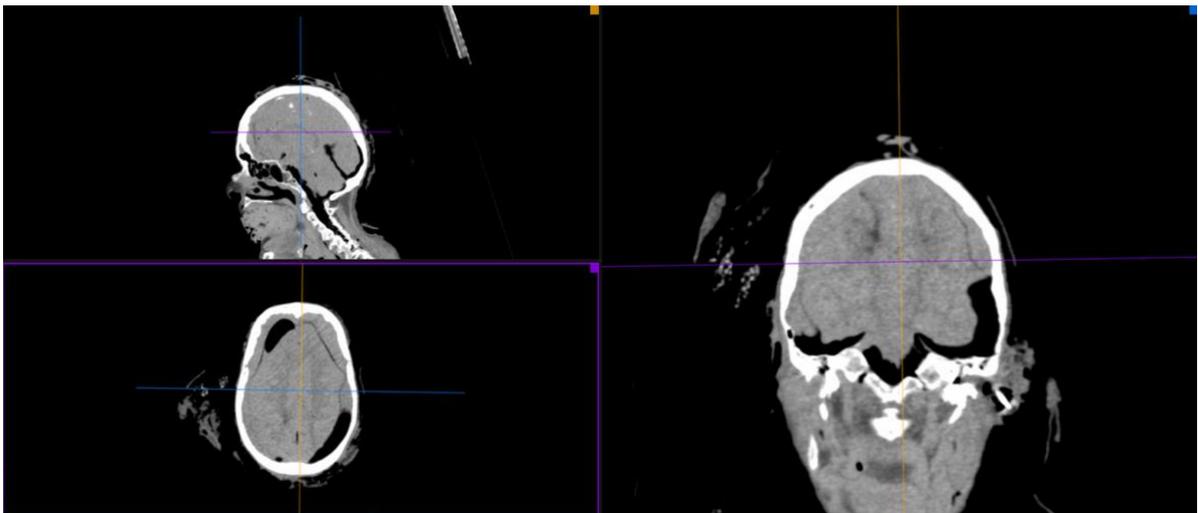


Figure 7. 3-panel projection (gray-scale).

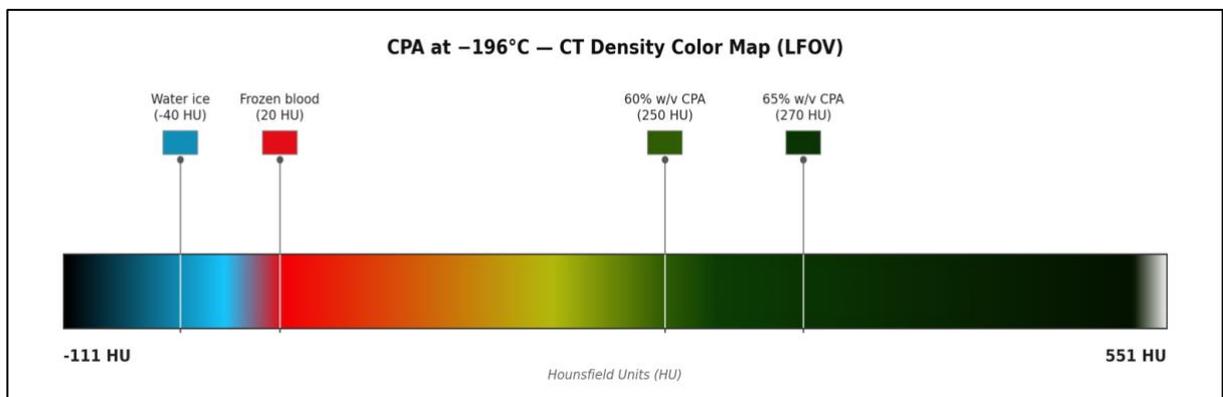


Figure 8. Color LUT.

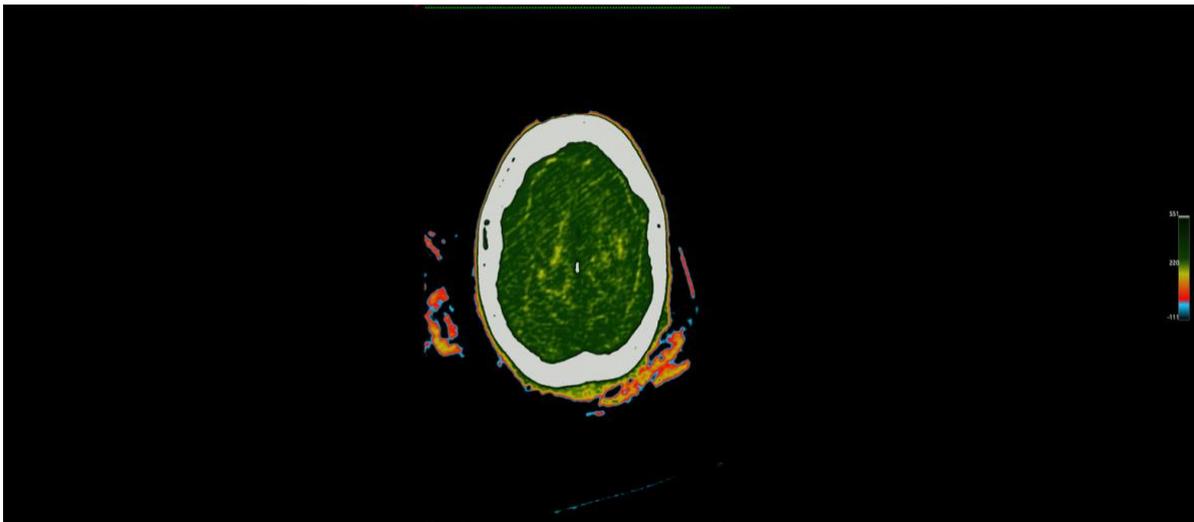


Figure 9. Axial plane CT slice 1.

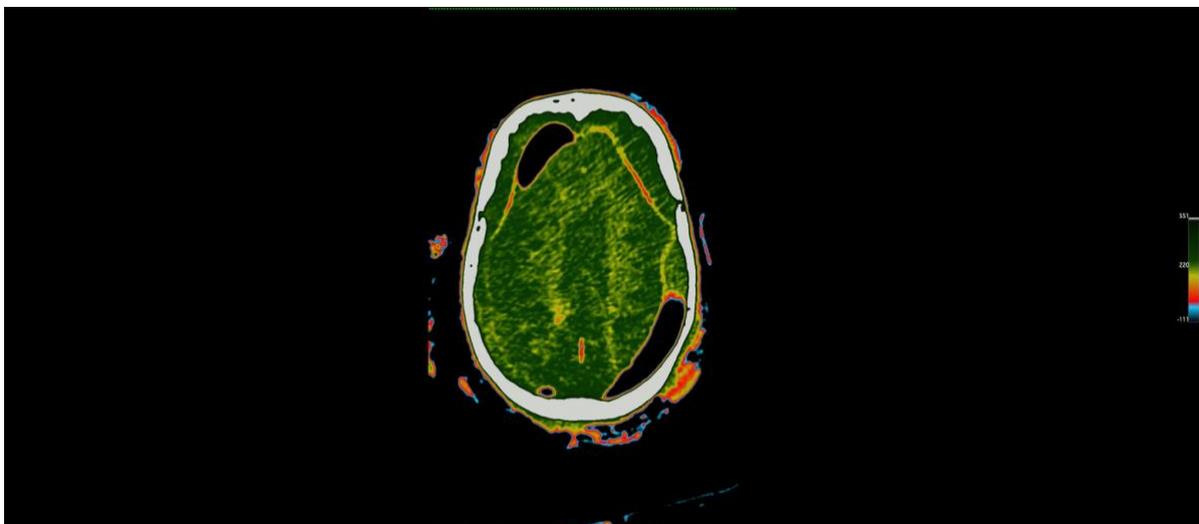


Figure 10. Axial plane CT slice 2.



Figure 11. Axial plane CT slice 3.

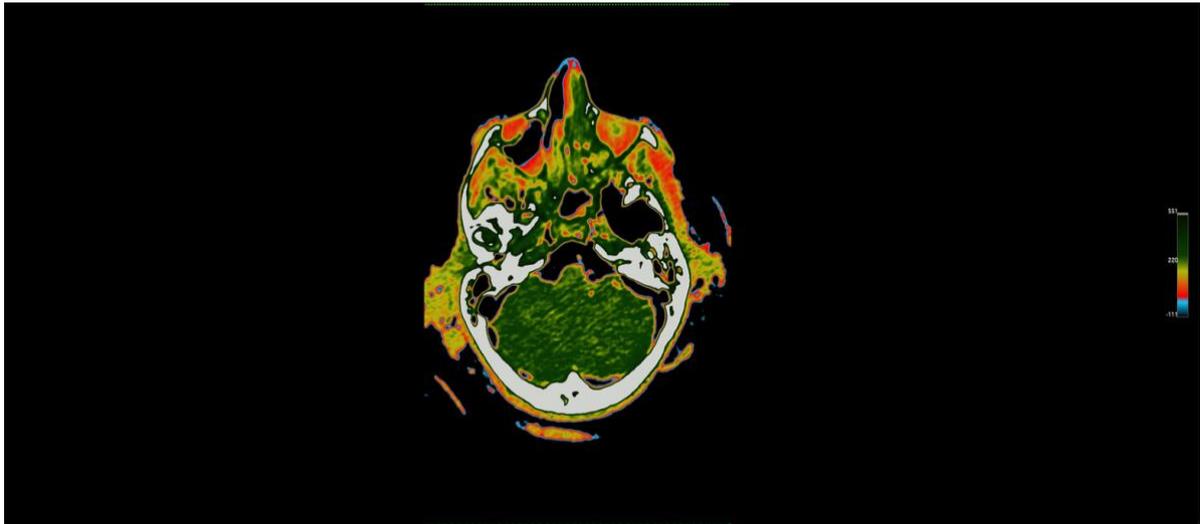


Figure 12. Axial plane CT slice 4.

Brain Shrinkage 2D Analysis



Figure 13. Brain shrinkage 2D analysis.

Brain shrinkage was calculated to be 37% based on a single 2D axial slice, without a comprehensive analysis of the brain's 3D volume.

Issues and Mitigation

Issue	Severity	Mitigation	Status
LUCAS stopped working	High	Ambulances packed with multiple batteries and chargers.	Completed
Ambulance battery ran out of power	High	1200 W solar panels to be installed. Battery bank quadrupled. Automatic charging station for ambulances.	Completed
Only two initial team members	Medium	Remote support was given to the team for guidance before additional in-person support joined.	Completed

Discussion of Results

CT scan shows uniform well-perfused brain tissue. Significant brain shrinkage (37% shrinkage) is also visible.

Timeline

Activity	Timestamp from cardiopulmonary arrest (minutes)	Timestamp from patient pick-up (minutes)
Patient transfer to ambulance	215	0
Chest compressions (LUCAS 2)	218	3
First medication administered	229	14
Final medication administered	238	23
Water and ice into bath	240	25
Thermocouples inserted	242	27
Squid pumps activated	255	40
Power loss in ambulance	288	73
Power back on in ambulance	375	160
Third and fourth team member arrive to ambulance	375	160
LUCAS deactivated due to battery level	398	183
First cut	398	183
Chest opened	403	188
Expert opinion taken online on cannula location	409	194
Perfusion started	422	207
Burr hole drilled	439	224
Two brain samples taken	631	416
Perfusion completed	657	442