Independent Cryonics Educators Program

3.3: Cryoprotective perfusion

Good practice in cryonics organizations involves working hard to perform standby and stabilization effectively and promptly. If the next stage of cryoprotective perfusion is compromised, however, freezing of tissue will occur, producing extensive damage to the fine structure of the patient's brain.

"**Perfusion**" means to circulate liquid through blood vessels. **Cryoprotective perfusion** is the circulation of solutions of cryoprotectant chemicals through blood vessels, through which the cryoprotectants reach cells and tissues to protect them against ice formation.

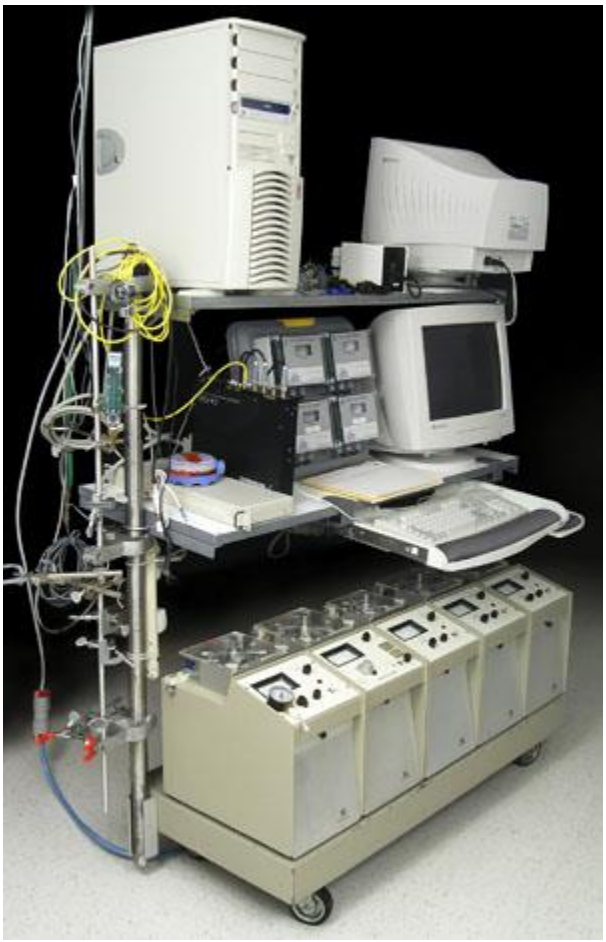
Since the beginning of cryonics, most people active in the field have sought to use cryoprotection to mitigate ice formation during storage at low temperatures. Since 2000, Alcor has gone further by introducing **vitrification** with the goal of eliminating freezing completely.

Our cells are full of water and other fluids that will freeze at low temperatures unless we do something to prevent this. In this part of the cryonics procedure, these fluids are replaced with a solution of **cryoprotectant agents (CPAs)**. Cryoprotectants can prevent water molecules from gathering together to form ice. CPAs can reduce freezing damage when the body or brain is cooled below 0° Celsius with the ideal being to eliminate freezing entirely.

To achieve this, blood vessels are accessed and perfusion techniques used to increase a gradually increasing concentration of CPA. Once the concentration has reached 50% of CNV (concentration needed to vitrify), the temperature is dropped from +3° Celsius to -3° and the ramping up is halted temporarily before solution addition continues until the desired concentration has been reached. At that point, perfusion will be discontinued and the patient will be gradually cooled to cryogenic temperatures for long-term care.

Since 2005, Alcor has been using 21st Century Medicine's low toxicity **vitrification solution** M22. This is the same solution used in state-of-the-art mainstream cryobiology for vitrifying complex mammalian organs. from temperatures between –45° C and -130° C with long term survival, and has enabled structural brain vitrification without ice damage. As the solution cools, molecules move slower and slower. At temperatures below -100° C, molecules become locked in place and a solid is formed. Cells that are treated with M22 or similar solutions do not freeze; they vitrify – a solid is formed without freezing, essentially stopping biological time.

Alcor uses a custom-built whole body **patient enclosure** that allows for surgical procedures, cryoprotection procedures, monitoring, and cooling. (A similar enclosure is used for neuropatients.) The patient is surrounded by ice packs during surgery and perfusion. The current enclosure enables the temperature to be dropped rapidly to –110° C. Another option is to use a separate cooling box. In the latter case, the inner metal lining of the surgical table can be detached and moved to the cooling box.



Perfusion equipment

Cryoprotective perfusion is not all-or-nothing; in some cases, perfusion will go poorly and there will be increasing edema (swelling). Surgical adjustments will be made to try to overcome this problem but if these are not successful, perfusion may be terminated. This means that sometimes it may only be possible to reach lower target concentrations, causing some ice to form, with the amount of ice depending on the final cryoprotectant concentration that was reached. This is very common for cases in which legal death occurs outside Scottsdale, Arizona, where Alcor is located.

References

https://www.alcor.org/docs/cryopreservation-procedures-section-18-cryoprotection.pdf

"How Cryoprotectants Work" in *Cryonics* magazine, 3rd Quarter 2007.

[Updated 09/07/22]

Next: 3.4: Field cryoprotection

ICE Program

Part I: ICE: Why is it important.

Part 2: Introduction to cryonics

Part 3: Procedural aspects

Part 4: Technical aspects

Part 5: Science

Part 6: Membership

Part 7: Concerns about cryonics

Part 8: Philosophical and ethical issues

Part 9: Cultural, religious, and social issues