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4.4: Cryopreservation vs. chemical fixation (chemical preservation)

Perfected cryonics would be completely reversible – a process sometimes called suspended animation. That means that vital functions have been temporarily halted and can be restarted without any damage. With perfected cryonics it would be possible to take a healthy human, put them into suspended animation, and then reverse the process so that the person continues their life without any physical or cognitive losses.

Cryonics today is far from that ideal. We can reversibly cryopreserve eggs, sperm, embryos, corneas, skin, heart valves, and other tissues. Doing the same with whole organs is challenging. There has been some success with rabbit kidneys but whole organisms lie beyond the realm of reversibility with existing methods.

Alcor strives to approach the ideal of reversible perfected cryonics. We want to preserve biological viability until the patient is preserved in an unchanging state and until revival is possible. This is consistent with viewing cryonics as an extension of emergency medicine.

As an alternative to cryopreservation, it has been suggested that we could preserve people *chemically*. Having observed the effects of chemical preservation on flies, Benjamin Franklin in 1773 pondered wistfully:

> "I wish it were possible…to invent a method of embalming drowned persons, in such a manner that they might be recalled to life at any period, however distant; for having a very ardent desire to see and observe the state of America a hundred years hence, I should prefer to an ordinary death, the being immersed in a cask of Madeira wine, with a few friends, until that time, then to be recalled to life by the solar warmth of my dear country. But since, in all probability, we live in an age too early, and too near the infancy of science, to see such an art brought in our time to its perfection…"

Is chemical preservation more promising today? Is it a workable, effective, or even superior alternative to cryopreservation? If the answers were positive, cryonics organizations would be well-placed to offer chemical preservation since it requires many of the same capabilities. However, Alcor is not currently providing this form of preservation.

One major reason is that chemical preservation goes strongly against the principle of maintaining tissue viability for as long as possible. Far from it, this process renders the tissue non-viable with a process that is irreversible today. Cryonics attempts to minimize and ideally eliminate damage from the process. By contrast, chemical preservation damages biological systems in several ways, depending on the chemicals used.

Sometimes people mistakenly use chemical preservation to mean the same as "plastination". In fact, plastination is a specific kind of chemical preservation developed in 1977 to preserve body parts for anatomical and educational purposes. It is not clear whether the combination of chemicals used retains everything needed to preserve memory and personality.

A major practical problem for chemical preservation is the slow rate of spread of the chemicals. For brains – and especially for whole bodies – tissues would remain unprotected while the preserving chemicals slowly approached them. Several years ago, a mouse brain was chemically preserved using external diffusion. The process took more than 250 hours. A human brain would take much longer. Further research may lead to faster times such as by cannulating blood vessels in the brain in addition to diffusion of chemicals.

Chemical preservation may not substantially lower costs compared to cryopreservation. It is not currently known whether chemical preservation at room temperature would be sufficiently stable. If it is stable at room temperature, expected savings could come from not having to maintain low temperatures.

Chemical preservation would still incur all the costs of standby, stabilization, transport, and treatment. This is a large part of the total cost while storage is much less of the total cost, especially for neuro patients. Also, without including a cost for storage, a chemical preservation organization would have no funds set aside for future reversal of the process.

Chemical preservation may appeal to those who want to be "uploaded" into a non-biological, computational substrate. Those proponents may not care that chemical preservation may be difficult or impossible to reverse. They may expect the preserved tissue to be sliced and destructively scanned and disposed of while the information extracted is used to build a software version of the person. The uploading scenario requires additional, controversial philosophical assumptions about the continuity of identity. Even if you have no problem with those assumptions, it remains the case that cryonics can also be a pathway to uploading; it just doesn't *require* it.

What about combining vitrification with chemical fixation to provide protection in case of premature warming? The problem with this is that chemical fixation increases intracellular ice formation and so increases the damage to non-vitrified areas of tissue. Unless this problem can be overcome, vitrification is a better option. We want to keep our preservation methods in line with professional medical practice and minimize damage done in the preservation process.

[10/31/22]

References

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Next: 4.5: Neurocryopreservation

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