Microbrain Bioreactors

Introduction

- This week our discussion will focus on microbrain bioreactors. We heard about the principles of bioreactor design from Dr. Grayson – about the importance of biomimetics strategies.
- In 2012, researchers at Vanderbuilt University received a grant from the National Center for Advancing Translational Studies to build an organ simulation system termed the "microbrain" bioreactor to use for drug testing. It is intended as an intermediary tool between animal models (with known difference from human brain biology) and human studies.
    - The article is listed in this week's readings and is available in eReserves.

Prompt

- This week, please consider the ethical boundaries for bioreactors in the context of the microbrain bioreactor.
    - Do you agree with the NIH (the funding mechanism) that development of the microbrain bioreactor is ethical?
    - Do you think there should be limits on the system (e.g. size of tissues grown, duration of growth, …)?
    - Please comment on how you think bioreactors should be used in tissue engineering.

Respond to at least tswo of your classmates.

Due: Initial post - Sunday 11:59 pm, responses - Tuesday 11:59 pm

The microbrain bioreactor can provide a more accurate representation of a natural brain than the ones provided by animal models or 2-D biological modeling platforms. By mimicking more closely a brain, this reactor could allow researchers to perform experiments which will be ethically unacceptable to obtain from humans or even animal models. Sacrificing or inflecting pain to animals, even for the principled goal of finding cures for devastating neurodegenerative or psychiatric disorders affecting an increasing number of people, is not a long-term strategy, especially knowing today, that many of the neuroprotective medications, which were validated in those models, have largely failed ([1]). Animal models or human-animal chimeras are useful but have their limitations due to anatomical, molecular, immunological, or pathological differences between animal and human brains. Today bioreactors which exist, are primitive compared to the real brain they are mimicking. Because of the existing gaps, researchers will eventually improve them, by increasing the size of the tissues or the length of growth, and they will become increasingly complex. As these bioreactors become more sophisticated, we can wonder; if eventually they will be conscious, express some self-awareness, feel pain or pleasure, blurring the lines between them

and a real brain. These bioreactors will provide new opportunities to understand and revisit major notions which are already controversial in our society like clinical death, or coma.
These developments will raise profound ethical concerns. But today is the time to start addressing them; defining what is ethically justifiable and the modalities of the future research using these bioreactors.

[1] S. Mobini, Y. H. Song, M. W. McCrary, and C. E. Schmidt, "Advances in ex vivo models and lab-on-a-chip devices for neural tissue engineering," *Biomaterials*, vol. 198, pp. 146–166, Apr. 2019, doi: 10.1016/j.biomaterials.2018.05.012.