

When The Pig Thinks: Human Identity & Ethics in Neural Xenotransplantation

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AUTHOR BIO

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ABSTRACT

If the Ship of Theseus remains the same ship after every plank is replaced, can a human remain the same self when parts of their brain are replaced with animal neurons? Neural xenotransplantation is the use of animal neural tissue to treat human brain disorders. While some successes in medical treatment have been noted, ethical concerns inevitably arise around cross-species integration, specifically the endangerment of human identity. This paper explores the scientific promise, clinical priorities, and philosophical implications surrounding neural xenotransplantation, arguing for cautious yet forward-thinking innovation.

EMERGENCE OF NEURO-XENOTRANSPLANTATION

Human fascination with combining species has been passed down through generations as myths and legends, ranging from Greek centaurs, half-man, half-horse, famed for their wise yet wild nature, to Werewolves, human-wolf hybrids, that dominate contemporary folklore as well as teenage fantasies. Today, no longer are these hybrids confined to stories as modern science pushes these limits through the concept of xenotransplantation — the transplantation of organs from one species to another.

Neural xenotransplantation, in specific, deals with the transplantation of animal neural cells or tissues into the human brain, often explored as a potential treatment for neurodegenerative diseases such as Parkinson's or Huntington's [1]. While neuro-xenotransplantation holds immense potential, it presents a catch-22, raising profound questions about identity, consciousness, and morality, as it involves altering the very structure that controls human thought and selfhood.

THE PROMISE OF NEURAL XENOTRANSPLANTATION

To account for the scarcity and ethical complications of human donor tissue, such as illegal organ harvesting, porcine xenografts are increasingly considered a preferable alternative [2].

A testament to the transformative nature of neural xenotransplantation is a post-mortem histological study done on a patient with Parkinson's disease who had received fetal pig neural cell grafts during his lifetime [3]. The results show that non-human dopaminergic cells

can survive transplantation in the striatum and further integrate, providing a therapeutic response to the disease. In addition, it has a very low immune reaction activation and has been documented to achieve 7.5 months of xenograft survival, surpassing previous trends of just 20-70 days.

While no new human trials have come underway since the 1990s, a plethora of cases involving rodents and other primates, genetically close to humans, have surged.

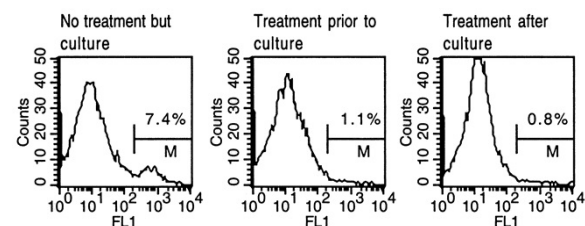


Fig 1: Graph showing the effect of human serum and rabbit complement treatment on the microglial cell content in dissociated porcine embryonic brain tissue. A reduction in microglial cells is observed following treatment, indicating decreased immunogenicity of the xenogeneic neural graft [4]

By treating nigral (dopamine-producing) pig tissue embryos with human anti-Gal antibodies to lower the tissue's immunogenicity, it was then grafted into the striatum of rats that had previously developed hemiparkinsonism using the neurotoxin 6-hydroxydopamine (6-OHDA) to mimic PD on one side of the brain [4]. Results positively indicate that the treatment nearly eliminated microglial content, reducing it to a mere 11–24%, thereby effectively terminating the ability of brain cells to stimulate human CD4⁺ T-cell proliferation, which is central to initiating immune response. This popular study, in addition to multiple others,

highlights how they might be a valuable tool in mitigating xenograft rejection.

CLINICAL PRECAUTIONS & ISSUES

The limited progress in human-based neural xenotransplantation is a consequence of rigid frameworks that call for absolute assurance beyond just proof-of-principle. Of these, three major areas include: i) tissue source, neurosurgery, and immunosuppression risks, ii) experimental data on graft function and survival, iii) immunosuppression protocols ensuring graft survival while minimizing risks for patients with neurodegenerative disorders [5].

Safety issues concerning neural xenotransplantation primarily revolve around immunological rejection and cross-species infection. While type I rejection is rare, delayed immune response of T-cells and macrophages still occurs and is managed with immunosuppressants like cyclosporine. These drugs, however, carry their own risks, including infection and kidney damage [1]. While most viruses, bacteria, and fungi can be eliminated from donor animals through specific pathogen-free breeding, the risk of zoonosis remains. Particularly, the transmission of porcine endogenous retroviruses (PERVs), which are present in the pig's fetal genome and cannot be removed. While harmless to pigs, they have severe ramifications for humans [2,5].

A TRANSGRESSION OF ONE'S HUMAN IDENTITY?

Societal ethical concerns are often perceived as more important than serious safety risks. In Gaskell's research, it is clear that typical human judgment is shaped less by scientific evidence than by moral concerns [6].

Suppose the soul and consciousness of a prince are transferred into the body of a cobbler. The person waking up in the cobbler's body would possess the memories and awareness of the prince, and hence would be the same person as the prince, despite not possessing his body [7].

In the context of brain transplants, if consciousness and identity are rooted in memory, what happens when memory-related brain regions are composed of non-human neural tissue?

Locke's prince-cobbler notion offers the unsettling implication that identity hinges on the continuity of consciousness, insinuating that biological integration alters one and gives rise to a hybrid conception of self. One's nature is prone to change, given the corresponding variations in the physiological parts vital to memory and personality.

Simultaneously, anthropocentrism - the idea that commends the superiority of humans amongst all other organisms - takes weight here, relieving us of the thought of becoming a pig-human crossbreed. Human consciousness is too exceptional or evolved to be simply transmuted by the introduction of foreign tissue. The pig neurons act as a support — a glue in reinforcing, not redefining, the human self.

While this is likely, human exceptionalism has been proven to emerge from a cultural and hierarchical basis, rather than an evolutionary one, mainly due to the revelation that neural functions, like empathy and complex problem-solving, are not exclusive to humans [8].

Philosophical ethology doubles down on this by critiquing animal behavior described as deterministic automatisms, i.e., it follows a simple stimulus-response machinery. It

recognizes them as agents who creatively use their capacities, such as judgment and adaptability, to navigate and shape their environment [9]. Thus, these arguments vehemently disapprove of the idea that xenografts cannot be considered to have significant aftereffects on one's psyche.

CONCLUSION AND PERSPECTIVE

While neural xenotransplantation possesses the astounding ability to treat neurodegenerative diseases, it challenges our deepest beliefs about what *makes* us human. The prospect of hybrid neural networks raises jarring questions from various philosophical, cultural, and religious viewpoints, as they mainly only consider the perspective of humans evolving into something foully uncharted by either violating God's will or operating against nature. Yet, from a pragmatic scientific perspective, this technology offers a groundbreaking opportunity to alleviate suffering and expand medicine's boundaries. While ethical considerations are essential to preserve the dignity and sanity of humankind, they must not hinder progress. Instead, they should guide responsible innovation.

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