
Ethical aspects of creating human organs in chimeric organisms

The creation of human/non-human animal chimeric organisms opens the perspective of generating personalized human organs. This technology could potentially solve the organ scarcity problem. However, there are serious ethical issues that have to be discussed before implementing such a practice. After initial definitions we will describe the ethical concerns, analyse them separately and provide a possible solution.

A chimera is an organism that consists of cells originating from different organisms that are genetically distinct.¹ Chimeras are classified as intra- or interspecific depending on whether contributing cells come from the same species or from different species.² In particular it is possible to create interspecific chimeras combining human and nonhuman animal cells. This would enable us to construct better disease models and generate personalized human organs with low risk of rejection.³

This promising technological perspective raises various ethical questions about whether we should create such chimeras and how to treat them. Mixing species can cause public discomfort ("yuck factor")⁴ and concerns about unnaturalness. Using a living organism, i.e. pigs or great-apes as a means of creating a human organ seems ethically problematic. Organs developed in animal hosts could constitute a source of zoonosis. Particularly delicate is the presence of human material in morally significant locations, such as the brain and the reproductive system. Here we face questions about human dignity and the moral status of such organisms.

General concerns include worries about unnaturalness or playing God and the so-called 'yuck-factor'. If we accept that nature and artifact are the two extremes of the same continuum, it is difficult to motivate why creating chimeras should be unnatural compared to various other examples of human endeavor, such as vaccines or antibiotics.⁵ As well, revulsion is not a good reason for ethical objections. Therefore, those general concerns can be considered ethically irrelevant.

Another risk concerns the potential creation of a new source of zoonosis, an infection that is naturally transmissible from vertebrate animals to humans⁶. Zoonoses can lead to a pandemic, as it happened in the case of COVID-19. The damages of such a pandemic are devastating on different levels and therefore it is questionable whether the benefits of creating a new source of organs are worth outweighing the potential harms.⁷ To answer this question, empiric analysis is needed to assess the risk for such scenarios. The principle of subsidiarity suggests

that the creation of chimeric organisms for such research is legitimate. Based on this, an ethical analysis can be conducted.

Another complex of ethical problems is about the moral status of chimera with human cells in morally significant locations such as the reproductive system. We consider the case of chimeras capable of human gamete production. This can only be problematic if we grant human gametes either an intrinsic or an instrumental worth. Granting them intrinsic worth means attributing moral status. A being possesses moral status when "in its own right and for its own sake, it can give us reason to do things such as not destroy it or help it".⁸ Since human gametes have no interests, they are unable to give us such reasons. Even if we accepted the intrinsic worth, it is difficult to see how this value should be ignored by creating them. Obviously, human gametes possess instrumental worth, for example they are used in in-vitro fertilisation. However, there is no moral status following from this assertion.⁹ The possibility that the interaction between gametes of different species results in a hybrid embryo is almost non-existent.¹⁰ Cross-breeding attempts between human and anthropoid apes failed when tested in the first part of the twentieth century.¹¹ In any case, sterilization of pigs bearing human organs would be sufficient to prevent their reproduction.¹²

Now we tackle the problem of using a non-primate living organisms as a means of creating a human organ without human material in morally significant locations. Compared to the widely practiced meat production, this seems to be unproblematic since the animal is used to create a life-saving organ, not only to produce meat. Therefore, the use of livestock animals as hosts for human organs should hardly pose serious issues in today's society.¹³ What's more, eradicating organ scarcity would require using just one out of 1000 large animals currently employed in the food industry.¹⁴ If we allow meat production, it is hard to decline the use of animals for organ production from an animal welfare perspective. In addition we have to bear in mind that similar issues have been raised previously by medical techniques that nowadays are accepted such as the application of porcine heart valves or porcine insulin.¹⁵

The case gets more complicated when questioning usual meat production. From a Kantian moral view, the use of animals is unproblematic since they are not granted any form of dignity.¹⁶ Therefore, an animal life is worthless and can be used as a means of satisfying human needs. Such an anthropocentric position attracts the reproach of speciesism.

From a preference utilitarianist perspective, the principle of equal consideration of interests, forwarded by Peter Singer, is central. It states that one should include all affected interests when calculating the rightness of an action and weigh those interests equally.¹⁷ This analysis embraces all feeling beings since such beings are assumed to have an interest in avoiding pain. Furthermore, Singer draws a distinction between persons and non-persons. To be a person, a being must have rational self-consciousness, as it is usually the case in humans or

great apes whereas chicks lack it. Pigs, a potential host for human organs, are somewhere in between. Besides, the creation of a pig-human chimera would promote well-being under the condition that this organism is enabled to live a life under fair conditions. From this utilitarian perspective, the creation of such chimeras seems justifiable since the interest of the human person not to die weighs heavily and the chimera would otherwise not even come to existence. Though, if we consider meat production, the interest of a human person in eating meat, which is not essential for surviving, seems unable to outweigh the interest of the animal.

Due to genetic affinity, great apes are particularly suitable for organ-growth. Cognitive capacities considered sufficient for full moral status would prohibit experimenting on or even killing it without its consent.¹⁸ Concerning the moral status of great apes, we again refer to the difference between persons and non-persons, whereas the former dispose of capacities associated with personhood: autonomy, rationality, self-awareness, linguistic competence, sociability, moral agency and intentional action.¹⁹ The degree of instantiation of those characteristics is decisive.²⁰ The question to answer is whether great apes are persons. There is a wide range of empirical evidence²¹ supporting the person-status of great apes: they use tools, perform intentional actions and social manipulation. They are self-aware and live in social structures, even proto-moral agency was observed. If we accept those findings, we can induce that the moral status and the cognitive capacities of great apes are at least very near to those of human beings. For the creation of such a chimeric organism for organ-growth, which involves killing the organism, very good ethical reasons are necessary. The improvement of the quality of life is clearly not among them. If there is the life of a human person at stake, sacrificing a non-human person with almost similar moral status seems inadequate as well. A problem occurring through the distinction of persons and non-persons concerns the moral status of human non-persons. This complicated issue shall not be tackled here.

If we endorse a distinction between persons and non-persons and deduce the moral status of a being based on this distinction, it is justifiable to use human/pig chimeras to grow life-saving organs. Of course, it has to be ensured that the living conditions for this organism are not inimical. The use of great apes, on the other hand, is morally problematic and therefore should be declined. Possible human gamete production is not a major ethical concern and sterilization enables to prevent it. The risk of zoonosis has to be taken seriously and empirically analyzed.

¹References

- ¹ Devolder, K., Yip, L. J., & Douglas, T. (2020). The Ethics of Creating and Using Human-Animal Chimeras. *ILAR Journal*. <https://doi.org/10.1093/ilar/ilaa002>
- ² Morata Tarifa, C., López Navas, L., Azkona, G., & Sánchez Pernaute, R. (2020). Chimeras for the twenty-first century. *Critical Reviews in Biotechnology*, 40(3), 283–291. <https://doi.org/10.1080/07388551.2019.1679084>
- ³ Shaw, D., Dondorp, W., Geijsen, N., & de Wert, G. (2014). Creating human organs in chimaera pigs: an ethical source of immunocompatible organs? *Journal of Medical Ethics*, 41(12), 970–974. <https://doi.org/10.1136/medethics-2014-102224>
- ⁴ Morata Tarifa et al., supra note 2
- ⁵ Koplin, J. J., & Savulescu, J. (2019). Time to rethink the law on part-human chimeras. *Journal of Law and the Biosciences*, 6(1), 37–50. <https://doi.org/10.1093/jlb/lasz005>
- ⁶ <https://www.who.int>. 2020. <https://www.who.int/topics/zoonoses/en/> (accessed june 26, 2020).
- ⁷ Shaw et al., supra note 3
- ⁸ Kamm, F.M. 2007. *Intricate ethics: Rights, responsibilities, and permissible harm*. Oxford: Oxford University Press
- ⁹ Palacios-González, C. (2015). Ethical aspects of creating human–nonhuman chimeras capable of human gamete production and human pregnancy. *Monash Bioethics Review*, 33(2–3), 181–202. <https://doi.org/10.1007/s40592-015-0031-1>
- ¹⁰ Bourret, R., Martinez, E., Vialla, F., Giquel, C., Thonnat-Marin, A., & De Vos, J. (2016). Human–animal chimeras: ethical issues about farming chimeric animals bearing human organs. *Stem Cell Research & Therapy*, 7(1). <https://doi.org/10.1186/s13287-016-0345-9>
- ¹¹ Martin J. Science (pas tellement) fiction à propos de l'homme — Notre société doit-elle formuler de nouveaux tabous? *Méd Hygiène*. 2004;(2500): 2039 – 40. <http://www.revmed.ch/rms/2004/RMS-2500.>
- ¹² Bourret et al., supra note 10
- ¹³ Morata Tarifa et al., supra note 2
- ¹⁴ Suchy F, Nakauchi H. Lessons from interspecies mammalian chimeras. *Annu Rev Cell Dev Biol*. 2017;33(1): 203 – 217.
- ¹⁵ Bourret et al., supra note 10
- ¹⁶ Kant, I. (1785). *Grundlegung zur Metaphysik der Sitten*. J. F. Hartknoch.
- ¹⁷ Singer, P. (2011). *Practical Ethics* (3 ed.). Cambridge University Press.
- ¹⁸ Robert Streiffer, At the Edge of Humanity: Human Stem Cells, Chimeras, and Moral Status, 15 *KENNEDY INST. ETHICS J.* 347 (2005)
- ¹⁹ Palacios-González, C. (2015). The ethics of killing human/great-ape chimeras for their organs: a reply to Shaw et al. *Medicine, Health Care and Philosophy*, 19(2), 215–225. <https://doi.org/10.1007/s11019-015-9658-1>
- ²⁰ DeGrazia, David. 2007. Human–animal chimeras: Human dignity, moral status, and species prejudice. *Metaphilosophy* 38(2–3): 309–329. doi:10.1111/j.1467-9973.2007.00476.x
- ²¹ De Grazia, supra note 20