XENOTRANSPLANTATION

What is Xenotransplantation?

It's the transplantation of living cells, tissues or organs from one species to another (e.g. transplanting a pig heart into a human).

Are Xenotransplants safe?

In decades of experimentation with xenotransplantation, the transplantation of organs from one species to another, no human recipient of a nonhuman organ has survived for more than a few months.

What are the main concerns surrounding Xenotransplantations?

The potential to spread pathogens including zoonotic diseases and retro-viruses, exploitation of human research participants, and animal welfare.

What is a retrovirus?

A retrovirus is a virus that uses RNA as its genomic material.

Upon infection with a retrovirus, a cell converts the retroviral RNA into DNA, which in turn is inserted into the DNA of the host cell. The cell then produces more retroviruses, which infect other cells.

E.g. of a retrovirus,
Besides human immunodeficiency virus (HIV), the virus that causes AIDS, there a two other retroviruses that can cause human illness - one is called human T-lymphotropic virus type 1 (HTLV-1) and the other is called human T-lymphotropic virus type 2 (HTLV-II).

Can Xenotransplantation transmit a retrovirus and why were Chimpanzees banned from Xenotransplantation?

Early research on xenotransplantation used organs from monkeys and chimpanzees, who are the closest phylogenetic and evolutionary relatives to humans. That research ended because of concerns about the transmission of pathogens, including retroviruses, some of which are readily transmitted from nonhuman primates to humans.

What is a zoonotic disease?

It's a pathogen that jumps from an animal into humans and it can exploit that new host's lack of defences, and cause illness.

Was Covid-19 a result of a zoonotic disease?

SARS-CoV-2 is a zoonotic virus that has been identified in many wild, captive, and domestic animal species.

What is the main goal and what are the challenges?

The ultimate goal of this research is to turn pigs into a ready source of organs for transplant, as part of the effort to address the chronic shortage of organs but as scientist Claus Hammer has described it, for xenotransplantation to succeed, "we need to 'outwit' the 180 million years of evolution.

Are there any ethical issues using pigs for research?

Pigs are genetically modified and cloned, and must be bred and housed using infection-control measures like artificial insemination, embryo transfer, Caesarian births, and isolation in sterile environments without contact with other animals, preventing the expression of their natural behaviours.

Does this violate any practices?

Using pigs and nonhuman primates for xenotransplantation research, or to grow organs, violates established best practices for animal care and welfare, which include providing ethologically appropriate environments that meet the animals' behavioural and physiological needs.

What are the 3Rs?

Replacement - Avoiding or replacing the use of animals in areas where they otherwise would have been used.
Reduction – Minimising the number of animals used consistent with scientific aims.
Refinement - Minimising the pain, suffering, distress or lasting harm that research animals might experience.

Does this research go against the 3Rs?

The use of pigs would require frequent blood and tissue sampling, which in pigs requires restraint, including drug-induced restraint. If pigs are used for multiple tissue and organ transplants, they could be subjected to repeated surgeries, causing these highly intelligent and social animals pain and distress.

What alternatives to using Xenotransplantation do we have?

Using expanded criteria organs, such as those from older donors and donors with chronic diseases, has already increased the supply of organs. Other solutions include the use of stem cells to grow human organs and possibly 3D bioprinting to repair organs.

Is there anything else we can do to reduce the demand for organs?

Access to basic health care and therapies to treat common diseases like hypertension, diabetes, and heart disease can prevent organ failure.

Changing to an “opt-out” donor registration scheme will encourage more people to become organ donors.

We can also make simple lifestyle changes to improve our overall health like stop smoking, exercise more, reduce the consumption of red meat (or cut it out completely), reduce alcohol intake and eat more vegetables.

What do participants sign up for when they become a trial for Xenotransplantation?

It requires lifelong surveillance of recipients to monitor for infectious agents. Not only does the participant receive lifelong surveillance but their close contacts, family, and sexual partners, and the transplant and health care teams should all be monitored for unexplained illness.

Does this contradict the right to withdraw from a research project?

Requiring lifelong surveillance effectively denies research subjects their fundamental right to withdraw, and violates international norms and ethical guidance.

What happened with the most recent Xenotransplantation subject?

David Bennett had a heart transplant using a genetically modified pig heart. He only survived for 2 months. Could he have survived longer without this procedure as they are now attributing the death to a pig virus still in the pig heart, which potentially caused an inflammatory response.