EXPLORING THE VIABILITY OF XENOTRANSPLANTATION

The **World Health Organization** estimates that whilst over 114,000 human-to-human organ transplants are performed annually, this accounts for less than 10% of global needs. Historically researchers have sought to address the shortage of human organs by exploring the viability of **xenotransplantation**, which involves the transplantation of animal organs into human patients. **Evolution Global**'s timeline infographic explores the history of xenotransplantation, from early surgical attempts through to modern clinical developments.

1838: First corneal xenotransplantation (pig to human) is performed.

1902: Alexis Carrel at the Rockefeller Institute describes how blood vessels could be reconnected in transplanted organs. He would go on to receive the Nobel Prize for his research in 1912.

1905: First corneal allotransplantation (human to human) is performed.

1923: From 1902 until 1923, transplants with pig, goat, sheep & monkey organs were attempted, but all fail rapidly. No further xenotransplantations are attempted again for several decades.

1944: University of London researcher Peter Medawar shows that the human immune system is responsible for failing transplantations. Medawar was awarded the Nobel Prize in 1960.

1954: First successful human-to-human transplantation is performed when doctors transplant a kidney between identical twins.

1960: The first immunosuppressive drugs for allotransplantations are identified.

1963-1965: Dr Thomas Starzl transplants baboon kidneys into six patients, with one surviving for 98 days. Keith Reemtsma transplants chimp kidneys into 13 patients, with one surviving for 9 months. The first animal-to-human heart transplant is attempted in 1964 using a chimp heart, but it fails rapidly. The first xenograft (animal-to-human tissue graft) aortic porcine valve is successfully implanted in 1965.

1969-1974: Three chimpanzee-to-human liver transplantations are attempted on children, with the longest surviving child lasting over 2 weeks.

1977-1978: Christiaan Barnard uses baboon & chimp hearts as temporary back-up pumps to treat a pair of patients suffering from heart failure, but the treatment fails to keep the patients alive. A year later doctors first use pig skin grafts to treat burn victims.

1984: A baboon heart transplant is performed on Baby Fae, an infant born with a severe heart defect. Baby Fae lives for 20 days post-transplant.

1992: Dr. Thomas Starzl transplants baboon livers into 2 patients, with one surviving for over 2 months.

1995: Cambridge researcher Dr David White creates transgenic pigs that create a human protein that prevents organ rejection. An HIV-positive man receives a baboon bone marrow transplant. His symptoms improve temporarily but the baboon cells die after a few weeks.

1996: Living Cell Technologies successfully transplants encapsulated pig islet cells into a Type-1 diabetic, enabling the patient to reduce insulin injections.

1997: Foetal pig nerve cells first used to treat patients with Parkinson's. Further research hits a roadblock as concerns over the risks of infecting humans with pig endogenous retroviruses (PERV) leads to a worldwide moratorium on xenotransplantation.

1999: Several researchers publish findings that there is no evidence of PERV infection in human recipients of pig tissues.

2001-Present: Some countries slowly lift the moratorium on xenotransplantation, with many countries approving on a case-by-case basis.

2007-2011: Researchers in Russia, Australia and New Zealand approve clinical trials that utilise porcine cells to treat Type 1 Diabetes.

2012: New Zealand gives approval to Living Cell Technologies to treat Parkinson's disease by transplanting encapsulated choroid plexus cells into human brains. Phase IIb trials commenced in 2016, with results expected in 2017.

2017: University of Maryland Medicine establishes nation's First Center for Cardiac Xenotransplantation Research. eGenesis researchers inactivate all the PERVs in a porcine primary cell line, subsequently generating PERV-inactivated pigs via somatic cell nuclear transfer.

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