Review Article

Xenotransplantation from Transgenic Animals: A Critical Analysis

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ABSTRACT: The current shortage in human organs has made xenotransplantation a potential source of organ transplant in humans. The use of primates could not provide the needed results in humans as many attempted organ transplants involving primate-to-humans were not so successful. Coupled with this, is their limited number and the fact that they are endangered species. Consequent upon this, transgenic pigs became the candidate of choice with the potential of solving this issue of organ shortage. Apart from having organ identical with humans, they have high reproductive rate and can be efficiently manipulated genetically to obtain desired results in humans. However, there are potential problems which exist with xenotransplantation using transgenic pigs as an alternative source. Currently, most of these problems are being overcome. This will not only reduce the problems of organ shortage but will open a new chapter in xenotransplantation from transgenic animals in the near future. This article discusses the potential benefits of using transgenic animals as a practical solution to human organ transplant. It further points out some of the potential problems of using these animals and how these problems are currently being overcome.

KEYWORDS: Xenotransplantation; Allotransplantion; Transgenic animals; Xenogenic; Zoonosis; Xenograft

Introduction

Xenotransplantation has become a promising area in recent times as a result of the shortage of allogenic organs (Bach, 1997). 1950s, allotransplantation (organ transplant between related species) was a major alternative for the treatment of end-stage disease of the liver, kidney, heart and lungs (Dorling et al., 1997). This is no longer so today, as the current shortage of human solid organs for transplantation has led to a sudden drift from allotransplantation to xenotransplantation (organ transplant between distantly related species). The number of patients awaiting organ transplant has increased over the years while the number of available donors has greatly reduced. As a result of this crisis in organ shortage, many people are left at the mercy of the availability of organs for their survival.

Xenotransplantation has a long history. In 1910, Unger carried out the first attempt in xenotransplantation which involved renal transplant from chimpanzees to humans. In this case, it was unsuccessful and the patient died due to blood clotting (Jonathan et al., 1995). Reemstma and colleagues also carried out a similar work with the intention of obtaining a positive result. However, there was a success of a nine month graft survival in one of the patients who later died. Another report was that of Starzl and co-workers in the same year. Here, they used a baboon-to-human transplantation but had a poorer graft survival. The patients in both cases were reported to have died as a result of infectious complications and nonspecific doses of high level of immunosuppressive agents that were used (Jonathan et al., 1995). Consequent upon these failures was the introduction of cyclosporine A in 1983 (Petersen et al., 2008), an immunosuppressive drug with the intention of overcoming the problem of rejection of xenogenic organs. Further to this, cyclosporine was administered to “baby Fae” after transplantation with a baboon heart. She was reported dead twenty days later (Bailey et al., 1985).

Several attempts of xenotransplantation from primates had not been so successful. In addition to this was the ethical issues raised in regards to their use, particularly the issue of self. Primates were considered endangered species and their number was equally at a decreasing rate. This has led scientists into the search for an alternative and better animal donor. Pigs were then considered as potential candidates of choice because ethical concern for pig is less and besides, they produce large size match organs with human and they have very high reproductive capacity with large litters (Turk et al., 2004). To be able to demonstrate this success in humans, pig-to-primate xenotransplantation was performed and some considerable successes were achieved.