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# Editorial

# Emerging technologies for development of humanized bio-artificial organs

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In the last two decade organ transplantation has rapidly amplified all over the world with good success rate. However, donor shortage is a major limiting factor for organ transplantation. As a result there have been a number of patients dying while on the waiting list for transplantation. There are several strategies being explored in order to create artificial organ support system. This has created new field of the cell and organ bio-engineering. The fundamental approach in this field is to create biological active three-dimensional organ. Recently discovery of the stem cells has added new dimension in providing highly proliferative cells in order to create artificial organ[1].

Xenogeneic organ scaffold provide an unlimited source for the artificial organ. Recently, decellularization and recellularization move toward whole organ building has emerged as exceptionally promising technology. Decellularization is defined as the technology used to eliminate all parenchyma cells, myofilaments, endothelial cells and extra cellular components from the organ while retaining its three-dimensional architecture and vascular tree. Recellularization is a process of generating functional cells within the decellularized organ scaffold to get fully functional bio-artificial organ. Few landmark studies on complex organs development, such as liver, heart, kidney and lung have provided a better insight into the supremacy of the methodology. These bio-artificial organs provide micro-vascular structure for efficient supply of nutrient and oxygen to each and every cell and solve the problem of availability of 3D-natural architecture and organ scaffold, immune rejection and others.

The primary synthetic organ in history conceded out was the trachea, also called windpipe. Several conditions lead to the resection of the windpipe including infectious disease, trauma, tracheomalacia, treatment with chemotherapy and radiotherapy for cancer[2].

Repopulated lung scaffold transplanted into rats survived for few hours with adequate $O_2$ and $CO_2$ exchange and appropriate pressure/volume relationships[3]. However the rat died because of pulmonary edema and/or hemorrhage ensuing respiratory failure. Ott et al[4] demonstrated perfusion of cardiac and endothelial cells into decellularized bio-engineered heart matrix and maintained in a bioreactor. After day-8, constructs could generate pump function in a modified working heart preparation. Embryonic stem cells were seeded in decellularized rat heart by Ng et al[5]. After 14 days, cardiac-marker expressing cells and endothelial or blood vessel cells developed into the heart. Blood vessels were observed which are essential for the transport of nutrients and oxygen to the heart after the scaffold was implanted back into the mouse. Lu et al[6] have demonstrated that heart ECM promotes cardiomyocytes proliferation and myofilament formation from the repopulated human multi-potential cardiovascular progenitor cells. Our centre has demonstrated that the decellularized whole-heart would develop the in-vitro studies for early procedures of heart development (Fig. 1A), which can further be build up into of personalized bio-artificial heart[7]. Goat provides one of the potential xenogeneic sources in comparison to porcine because of the pre-formed antibodies against porcine antigen (α (1, 3) Gal epitope). Hence our study has

demonstrated that goat kidney as a source for the development of natural 3D organ scaffold (Fig. 1B)[8]. This approach may provide a model for better understanding of whole organ regeneration. These will be a source for suitable organ for the transplantation. Baptista et al[9] provided an important tool for the creation of a fully functional bio-engineered liver by perfusion decellularization of rat liver after removing the cellular components and preserving the macro-vascular tree of the entire liver. The cells within the repopulated liver displayed typical hepatic, endothelial and biliary epithelial markers.

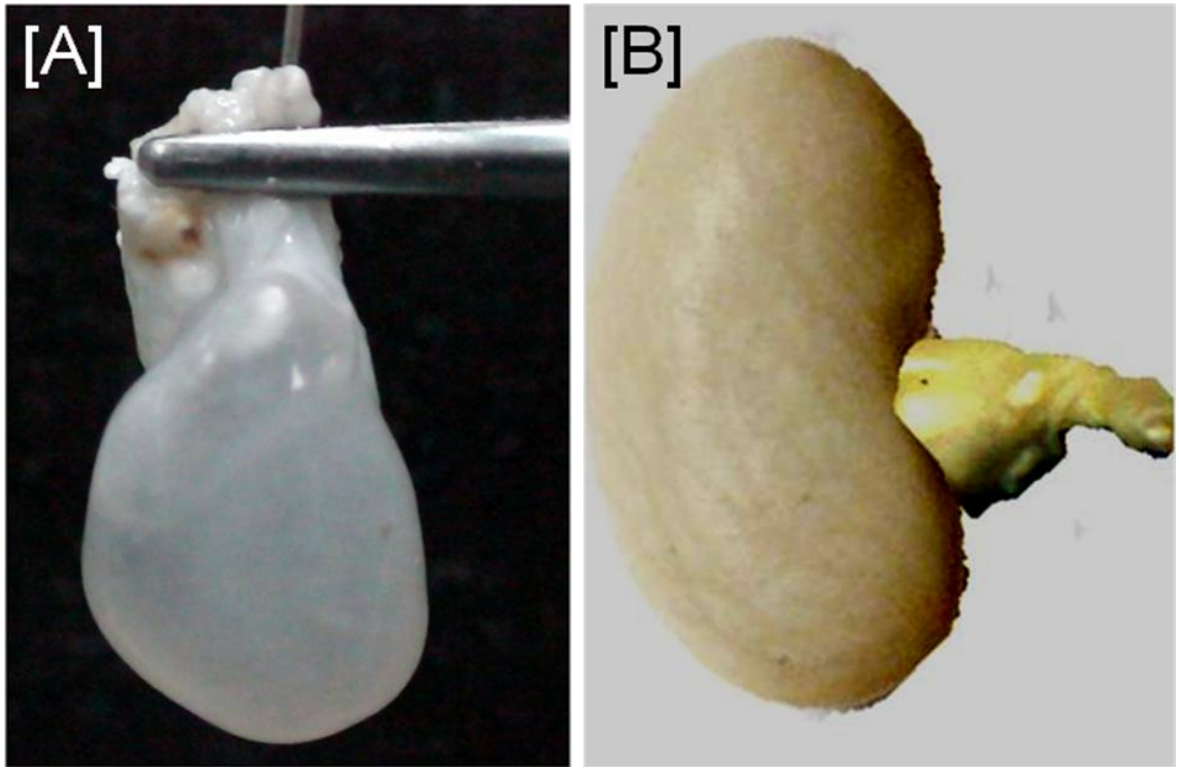


**Fig 1.** Decellularized xenogenic (A) heart and (B) kidney for their future applications as extra-corporeal support systems or to bridge the organ transplantation

In summary, a substitute way to treat patients other than transplantation, numerous researchers and technologies around the world rose up and several of them gave hope for the future. Preparing a synthetic bio-artificial organ is a technology that uses stem cells to build a novel organ that could function as standard organ and applied as extra-corporeal support system in patients to bridge the organ transplantation.

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