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Current Transplantation Technologies: A Brief Overview

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Introduction

Significant advancements in the fundamental scientific explorations as well as the validation and application aspect of scientific principles resulted in the technological sophistication for successful transplantation of organs. Modern-day technologies are revolutionizing the way the organs are sourced, transported, and transplanted. These technological advancements include robotic and remote surgery, tissue engineering, functional transplantation, nanotechnology-based surgical therapy, machine perfusion, artificial organ development, artificial intelligence, mobile health technology, stem cell therapy, repair of organs under *ex vivo* conditions, organ transport, and transplantation. This report highlights some of the most significant contributions in past one year that enhanced our understanding of transplantation technology.

The technology of the human pancreas-on-a-chip is used for complex *in vitro* modeling of islet cell physiology. Abadpour et al. (2020) reviewed various developments toward the advancement of PoC technology for clinical transplantation and summarized the progress and further evaluated its possibility for successful clinical islet transplantation. The authors have suggested that microfluidic designing by using imaging-compatible biomaterials and biosensors might provide a reliable tool for predicting islet transplantation outcomes. As per the study, combining islets with other tissue types enables the study of diabetic interventions under *in vitro* environment could potentially replace animal testing in the development of diabetes interventions.

Regenerative medicines are used to repair and regenerate poorly functioning organs and have an immense role in the regeneration of native cell lines, growth of new tissue, organs, modeling of disease states, and augmenting transplant organ viability. It is also used as astrategy to counter immunosuppression for reducing postoperative complications, toxicities, and bypassing anti-rejection therapy. Technologies based on regenerative medicine determine the efficacy level of allograft transplantation. Edgar et al. (2020) conducted a literature review for deriving interpretations on innovations in organ bioengineering and advances in regenerative medicine in organ transplantation of kidney, pancreas, liver, heart, lung, and intestine. It was noted that there exist several innovative strategies such as decellularization, fabrication of a cellular scaffolds for organ manufacturing, three-dimensional printing, blastocyte complementation between species, and the use of induced pluripotent stem cells to mitigate ethical concerns associated with embryonic stem cells.

Gruttadauria et al. (2020) have reported the use of near-infrared technology for evaluating the split graft during standard orthotropic liver transplantation with intravenous injection of indocyanine green. The authors suggested that fast diffusion of the colorant allows dynamic and early evaluation to confirm the presence of intrahepatic venous shunt and for determination of full recovery of the ischemic area. The study results were found to conform with a contrast-enhanced CT scan that was performed before discharge.

Biomarkers generally indicate the physiological orpathological process or stage. Ideally, biomarkers are non-invasive, affordable, quantifiable that correlates with diseases condition precisely across gender and ethnic groups. Guerrero-Miranda and Hall (2020) have expressed the need for evolving a technology that uses non-invasive, high sensitive, and precise biomarkers for the detection of allograft rejection in adult heart transplants and that which could be applied earlier in the immunogenic pathway.

Leucoderma is a common depigmentation skin disorder. Mei et al. (2020) have demonstrated that during *in vitro* cell culture following magnetic cell separation, the number of melanocyte stem cells decreased while the mature melanocytes increased thus indicating efficient differentiation of melanocytes stem cells. This finding has immense relevance for application as skin transplantation technology for treating leucoderma.

Transplantation technology & research is an open-access peer-reviewed journal that forms a source of updated knowledge for biomedical engineers, clinicians, surgeons, general and transplantation specialists, clinical researchers, resident students, fellows, interns, trainees, transplant procurement professionals, laboratory technicians, pathologists, and immunologists. The journal covers the ethical and religious aspects of organ transplantation, embryonic organ transplantation, normothermic graft perfusion, tolerance, pharmacogenetics, immunosuppression, viral transmission during organ transplantation, pediatric and split liver transplantation, portopulmonary hypertension, mechanical circulatory support, *ex vivo* lung perfusion, and ABO incompatibility in kidney transplantation.

Conclusions

Transplantation technology will play an important role in future healthcare. Significant progress was made during the laboratory experiments and with animal model studies for the development and advancement of transplantation technologies. However, the translation of the study outcomes into clinically significant and valid applications remained relatively slower. Therefore, there is a need for concerted efforts across disciplines for the development of advanced technologies and this could be very well achieved by rapid and widespread communication of research outcomes.

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