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To the lay public, organ transplantation to replace damaged organs and tissues stirs many feelings, ranging from hope to fear. Whether the transplanted tissue is sourced from cadaver or living donor-derived cells and tissues, scientists have endlessly pressed forward to advance the study of various organ transplantations, applying valuable knowledge gained from the development of various cutting edge techniques to allow the regain of healthy functions lost to age and disease. Medical technologies that allow us to restore normal health have come under the field of regenerative medicine. Among the most hopeful of technologies enabling regenerative medicine is that of stem cell therapy. This special issue of Hanyang Medical Review has, therefore, been organized to examine the therapeutic possibilities of a variety of stem cell types (from pluripotent to adult) for chronic human diseases such as diabetes, chronic hepatitis, and cerebrovascular diseases. The recent innovative application of 3D bioprinting to tissue engineering in regenerative medicine is also examined herein.

This volume also examines some of the recent advances in solving various problems associated with transplantation in regenerative medicine including mechanical circulatory support, immune tolerance, ABO incompatibility and chronic allograft rejection. Jang et al. [1] will extensively review the recent trend of hepatic stem cells including therapeutic applications of hepatic stem cells from various stem cell sources. All human organs are composed of various kinds of cells, and these cells are continually injured by many environmental insults. Tissue regeneration is essential for tissue repair and maintenance of organ function. Unlike other organs, liver is a fundamental organ for homeostasis with unique regenerative capacities and contributes to physiological detoxifica-

tion, metabolism, synthesis and regulation. The liver is unique in that hepatic regeneration under specific injury like partial hepatectomy, the liver can be fully regenerated through the proliferation of only the adult hepatocytes without participation of any stem cells. However, in pathologic conditions like liver cirrhosis, the liver fails to regenerate [1] and organ transplantation was the only treatment for regeneration of the liver function [1]. Liver transplantation remains one of the best treatment options for chronic liver diseases, but wider utilization is hampered by several problems including donor shortage, immune rejection and surgical complications. In this issue, recent advances in the differentiation of pluripotent stem cells and adult stem cells into hepatic cells, and their potential use in regeneration of liver function has been described.

Recently, tissue engineering techniques have been developed that make this area of investigation one of the most important tools for organ transplantation with regard to synthetic generation of organs for transplant. While tissue engineering is very primitive in this early stage, recent advances in technologies such as 3D printing and reconstitution of decellularized matrix with stem cells to generate functional organs for transplant are promising to provide the next generation tissue engineering tools to allow new sources for transplant therapies [2,3].

Cell transplantation could be another alternative intervention that could substitute organ transplantation temporarily or partially. Recently, graft survival of islet transplantation has improved dramatically. However, there are lots of limitations of cell transplantation. Especially, hepatocyte and islet transplantation will be reviewed by Lee et al. [4] and Park et al. [5].

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Over the last decade, advancements in genetic technologies have increased our knowledge of genetic diversity across the human. While organ transplantation is widely considered the best current curative therapy for organ dysfunction, genetic research has not yet contributed a major impact to transplantation medicine except in HLA matching. Pre- and post-operative care including surgical techniques have been improved to reduce morbidity and mortality within organ transplantation. The promise of personalized medicine using genomic analysis, will likely lead to further development and improvement of organ transplantation results. Novel high-throughput sequencing technologies will be discussed in this review especially in regards to the obstacles and opportunities associated with bioinformatics and biostatistics. Choi et al. [6] will cover overviews of current knowledge of genomics on organ transplantation and summarize potential benefits of genomics in clinical transplant medicine.

Cardiac transplantation is currently the only option for refractory end stage heart failure. The number of heart transplantations has increased and the survival rate has improved during the last 3 decades due to advances in our understanding of immunology and rejection, pharmaceutical development and clinical management of donors and recipients. However, only a fraction of patients can be offered transplant due to a shortage of donor hearts and many patients suffer high mortality while waiting for suitable hearts to become available. Technical advancement of mechanical assist devices in recent years has enabled long term implantable Left Ventricular Assist Devices that can allow patients to bridge high mortality in the waiting list to transplantation and to assist as a long term destination therapy for patients who are not eligible for transplantation. Other advances include the development of a solid phase assay that has increased the sensitivity and specificity of detection of HLA antibodies in the recipient. It has enabled the identification of unacceptable HLA antigen, allowed physicians to acquire calculated PRA and perform virtual cross matches that enhance the efficacy of donor allocation to decrease waiting time, obviating prospective cross matches to decrease ischemic time and that evaluate the risk of rejection in presensitized patients. Antibody mediated rejection is a challenging entity in diagnosis and management. However, a standardized classification of histology and immunology of endomyocardial biopsy has been developed recently and immunotherapy is moving toward targeted therapies directed at antibody production and function. This review focuses

on those major changes in the heart transplantation field in the last decade. Lee et al. [7] will provide an overview of past, present and future of mechanical circulatory support as bridge to transplantation, and recent hot topics of heart transplantation.

With advances in molecular biology of transplantation, many outstanding outcomes of organ transplantation have been demonstrated involving immune tolerance, ABO incompatibility transplantation for liver and kidney, and chronic allograft rejection. Choi will discuss the updates of current issues on immune tolerance [8]. ABO incompatibility and chronic allograft rejection will be touched by Song [9] and Chung et al. [10].

Although there have been many advances in cutting edge technologies in science and tremendous progress in organ transplantation, still, many hurdles remain to resolve in this still developing field of transplant and regenerative therapy. Given the complexity of organ transplantation, a multidisciplinary team approach including biology, molecular biology, epidemiology, pathology, surgery, public health and supportive care is required to continue our progress. Finally, I am very proud and happy to work with three brilliant medical student authors (Jang JW, Lim GE, and Choi HS) who actively devoted their hope and energy to work together developing these materials reviewing the rapid advancements in transplant and regenerative medical therapies.

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