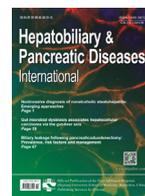




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Letter to the Editor

International Organ Protection Symposium: The fusion of engineering and medicine

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The International Organ Protection Symposium was held in Toronto, Canada on May 15–16, 2019. This symposium focused on the fusion of engineering and medicine, bringing together experts in organ transplantation, organ repair, artificial organs, precision medicine, automation, micro and nanotechnologies. This letter highlights some of the innovative and impactful presentations in this symposium.

Dr. Mitesh Badiwala, Director of Heart Transplantation Program at University Health Network, gave a speech of “Cardiac transplant advances in donation after circulatory death”. Dr. Badiwala introduced the history of heart transplantation and the donor organ shortage crisis. He pointed out that *ex-situ* heart perfusion allows the resuscitation of donation after circulatory death and expand organ pool. He reviewed the contemporary heart transplant research after circulatory death and shared his experience. At the end of his speech he showed the current challenges and future directions in heart donation after circulatory death.

Dr. Li from the First Hospital of Kunming, China, gave us a speech about “What next should be done for organ donation and transplantation in China”. China stopped using organs from executed prisoners since January 2015, and citizen’s voluntary organ donation after cardiac death becomes the only source for organ transplantation [1]. The voluntary organ donation after cardiac death in China has been increased dramatically since 2015. The organ donation law that meets the international standards and the demand of Chinese people is established.

Dr. Yu Sun and Dr. Liming Xin from the Faculty of Applied Science & Engineering at University of Toronto, Canada jointly gave us a speech of “Adaptively perfusing a human organ-engineering meets medicine”. Dr. Sun introduced the importance of engineering to medicine. In his talk, he provided an overview of robotics and instrumentation technologies in medicine from micro-nanometer scales to macro scales. Dr. Xin introduced the

current research of adaptive perfusion of isolated heart. He presented how the adaptive controller they developed provides personalized perfusion conditions to improve the heart quality in preservation.

Dr. Ren-Ke Li from Toronto General Hospital Research Institute gave us a speech about “Conductive biomaterial to prevent cardiac arrhythmia”. He focused on translational research to apply new insights discovered through basic science research to potential clinical applications for heart regeneration and repair after myocardial infarction. Their group discovered a new conductive biomaterial which can be injected to damaged myocardial tissue to regenerate myocardium and restore heart function.

Dr. Jian-Hui Li from the First Affiliated Hospital, Zhejiang University School of Medicine, China gave us a speech about “Whole process of organ transportation and repair technology development”. Organ transplantation remains the best treatment for the end-stage organ failure. Establishment of strategies and techniques to protect graft is urgently required for the function recovery and to increase the donor pool. Our group developed the first organ transport quality control system integrating “hardware acquisition + cloud center + mobile application + internet collaboration” in China. The whole process management included organ transport, real-time monitoring of transport information and organ quality indicators. This is the first full-automatic organ repair system in the world. Organ can be repaired, and is expected to reduce the waste rate of organ from 30% to 5%.

Dr. Di Lu from the First Affiliated Hospital, Zhejiang University School of Medicine, China gave us a speech about “Precision medicine in liver transplantation for hepatocellular carcinoma”. In China, there are 93 million HBV carrier and more than 554 thousand new hepatocellular carcinoma cases per year [2]. Liver transplantation is an optimal radical therapy for selected patients with hepatocellular carcinoma. Clinical trials showed that Hangzhou criteria expanded 51.5% of Milan criteria for LT candidates and 5-year survival rate are 72.5% which is comparable to the studies based on Milan criteria [3]. Hangzhou criteria is still applicable in candidate selection of liver transplantation.

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Dr. Dong-Yi Chen from University of Electronic Science and Technology of China gave us a speech about “Smart wearable and health care”. Currently, smart wearable has become a cutting-edge technology. Health-care and fitness are the most important areas for smart wearable. Smart wearable technology can realize continuous, hidden, unimpeded and accompanying observation for human activities, physiological and psychological conditions, and then create innovative concepts, methods, technologies and products for multi-dimensional and time-space measurement of health status.

Dr. Jun-Jun Jia from the First Affiliated Hospital, Zhejiang University School of Medicine, China, presented “The basic study of machine perfusion for liver graft regeneration”. Recently publications in *Nature* showed machine perfusion was associated with a 50% lower level of graft injury and a 50% lower rate of organ discard [4]. Machine perfusion is a novel technique and already applied in clinical practice [5]. Machine perfusion for regeneration is an interesting topic; in our previous work we found that machine perfusion enhances hepatocyte regeneration, especially for the small-for-size liver transplantation [6]. We used HO1 knock out and small-for-size liver transplantation models and got the conclusion that HO1 mediate machine perfusion-induced liver regeneration via the regulation of HGF-AKT axis.

Organ transplantation is one of the most important achievements in medicine in the 20th century and an important indicator for measuring the medical level of a country. The organ transplantation in China has been standardized and legalized in the past five years. A total of 19,895 Chinese citizens have donated their organs in five years and nearly 18,000 cases of liver transplant have been completed (data from China Liver Transplant Registry). To make up for the shortage of organs, more and more marginal organs are being used in clinical practice, thus questions on how to evaluate, maintain, and even repair such kind of organs are major topics for investigators. Mechanical perfusion is a novel model for the fusion of engineering and medicine, especially normothermic mechanical perfusion which sheds the light on organ protection and organ shortage crisis.

Organ transplantation needs innovation and development, and it is essential to reduce postoperative complications, and to

improve the prognosis of recipients. “Toronto declaration” aimed to promote the development and the application of technologies of organ protection for the benefit of the people worldwide was signed in this International Organ Protection Symposium, which will further pool the strength and wisdom of transplantation experts to create a more brilliant future for organ transplantation.

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Competing interest

No benefits in any form have been received or will be received from a commercial party related directly or indirectly to the subject of this article.

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