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Editorial

Pluripotent Stem Cells for Regenerative Medicine

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Since the first successful culture and maintenance of human embryonic stem cells reported by Thomson's group [1], the research activities of pluripotent stem cell showed steady increases from the statistic data of published literature (Figure 1). And the trend of exponential growth in pluripotent stem cell areas showed in the data may be attributed to another excited progress of reprogramming somatic cells to induced pluripotent stem (iPS) cells by Yamanaka's group [2,3]. Not to mention that it caused the paradigm shift of fundamental biological concept, the enormous potential impact in the fields of biotechnology and biomedical engineering was expected to happen from the near future.

As mentioned by Dr. Yamanaka himself, the most practicable application of iPS technology currently is for drug screening. In the past, potential drugs were tested in the animal first before going to clinical human trials. Unfortunately, many studies have shown the discrepancy of results between animals and humans. Therefore, using the differentiated cells derived from human iPS cells for drug screening will be a versatile tool to get insights about how human cells respond to the potential drugs. Another interested application is to develop the human disease model in the dish. Similar to the case of drug screening, in vitro model of human cells derived from patients is expected to accelerate the discovery of the disease mechanisms and the development of novel therapeutic approaches, especially when it combines with the high throughput screening.

The third potential application of iPS technology is for cell therapy. Some diseases are caused by the functional loss of specific cell types. For instance, type I diabetes are associated with β-islet cells and Parkinson's diseases are with the dopaminergic neural cells. The rationale of using patient derived iPS to obtain the specific differentiated cells for the treatment of such diseases is easy to understand. It is obvious that many unknown questions need to be answered before applying cell therapy for clinical application. In addition, the combination of lineage-specific cells derived from iPS cells with the biomaterials to engineer three-dimensional tissue constructs for basic research and translational application is another exciting application. We recently have a review article [4] to discuss the potential application for using pluripotent stem cell derived neural lineage cells with biomaterials for neuroscience and neuroengineering.

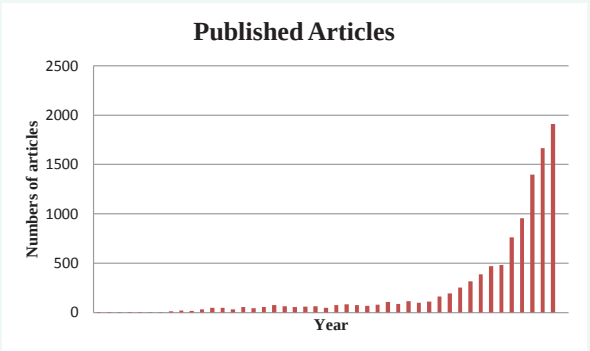

Figure 1 The data were obtained by searching the database of PubMed with the keyword "pluripotent stem cells" from 1964 to 2012.

In summary, the exponential growth of pluripotent stem cell research in the past few years indicated a clear trend for biotechnology and biomedical engineering. Although pluripotent stem cells are full of promises, many challenges are still there waiting for the scientists and engineers to overcome. But no doubt, the progress of this field will finally result in fruitful applications for all human beings.

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