CRISPR-Cas Antiviral Strategies

Foreword

The CRISPR (clustered regularly interspaced short palindromic repeats) Cas9 (CRISPR-associated 9) system has become a powerful and favorite tool for sequence-specific RNA-guided editing of cellular DNA genomes. This endonuclease activity evolved within prokaryotes as adaptive immune system to attack the nucleic acids derived from bacteriophages and other foreign genetic elements. Nowadays, the system can be exploited as antiviral approach against a variety of pathogenic viruses in humans and plants. CRISPR-Cas is a game-changing technology that has been used explosively not only as a powerful tool for precision genome editing in biomedical research but also as novel therapeutics. It was heralded as “Breakthrough of the Year” by Science magazine in 2015. Within a short period of time the CRISPR-Cas storm has swept across biology and medicine, with good potential to enter the clinic ultimately. In particular, CRISPR-Cas has brought revolutionary thoughts and enabling technologies to virology. CRISPR-Cas editing has been used successfully to knock-out the expression of viral and cellular genes. CRISPR-Cas knockout is easier, faster and cleaner compared to existing technologies such as RNAi knockdown. The development of CRISPR-Cas antiviral strategies is an emerging field that might impact future practice of medicine. On one hand, CRISPR-Cas knockout of host dependency factors required for viral replication and infection can put out the fire by taking away the oxygen. On the other hand, direct targeting of viral or proviral DNA by CRISPR-Cas strikes at the root of the trouble and has the potential to eliminate the virus from the infected cell. Both approaches promise to change how viral diseases will be treated in future. This Special Issue on CRISPR-Cas Antiviral Strategies is therefore timely in providing a collection of reviews and research articles on this topic. We hope that both experienced users of CRISPR-Cas9 and new comers to the field can benefit from this Special Issue. Wei Cun and collaborators (Chinese Academy of Medical Sciences and Peking Union Medical College, China) discuss the selection pressure imposed by the CRISPR-Cas system on herpes simplex virus (HSV) genomes. Dong-Yan Jin (School of Biomedical Sciences, the University of Hong Kong) discusses suppression of the Epstein-Barr virus (EBV) DNA load in nasopharyngeal carcinoma cells. Two manuscripts deal with the development of antiviral strategies against the hepatitis B virus (HBV) that has a DNA-phase: Pei-Jer Chen and colleagues (National Taiwan University, Taiwan) and Patrick Arbuthnot and colleagues (University of the Witwatersrand, South Africa). The latter report also deals with approaches against the hepatitis C virus (HCV) with an RNA genome. Atze Das and colleagues (University of Amsterdam, the Netherlands) review diverse CRISPR-Casbased antiviral strategies against the human immunodeficiency virus type 1 (HIV-1). Finally, Magdy Mahfouz and co-workers (King Abdullah University of Science and Technology, Saudi Arabia) describe the engineering of Tobacco rattle virus (TRV) and Pea early browning virus (PEBV) to deliver sgRNA reagents into Nicotiana benthamiana and Arabidopsis thaliana plants.

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