Advances in Experimental Medicine and Biology

Volume 1248

Series Editors

WIM E. CRUSIO, Institut de Neurosciences Cognitives et Intégratives d'Aquitaine, CNRS and University of Bordeaux UMR 5287, Pessac Cedex, France

JOHN D. LAMBRIS, University of Pennsylvania, Philadelphia, PA, USA

HEINFRIED H. RADEKE, Institute of Pharmacology & Toxicology, Clinic of the Goethe University Frankfurt Main, Frankfurt am Main, Germany

NIMA REZAEI, Research Center for Immunodeficiencies, Children's Medical Center, Tehran University of Medical Sciences, Tehran, Iran Advances in Experimental Medicine and Biology provides a platform for scientific contributions in the main disciplines of the biomedicine and the life sciences. This series publishes thematic volumes on contemporary research in the areas of microbiology, immunology, neurosciences, biochemistry, biomedical engineering, genetics, physiology, and cancer research. Covering emerging topics and techniques in basic and clinical science, it brings together clinicians and researchers from various fields.

Advances in Experimental Medicine and Biology has been publishing exceptional works in the field for over 40 years, and is indexed in SCOPUS, Medline (PubMed), Journal Citation Reports/Science Edition, Science Citation Index Expanded (SciSearch, Web of Science), EMBASE, BIOSIS, Reaxys, EMBiology, the Chemical Abstracts Service (CAS), and Pathway Studio.

2018 Impact Factor: 2.126.

More information about this series at http://www.springer.com/series/5584

Jie Xu Editor

Regulation of Cancer Immune Checkpoints

Molecular and Cellular Mechanisms and Therapy



Editor Jie Xu Institutes of Biomedical Sciences, Zhongshan-Xuhui Hospital Fudan University Shanghai, China

ISSN 0065-2598 ISSN 2214-8019 (electronic) Advances in Experimental Medicine and Biology ISBN 978-981-15-3265-8 ISBN 978-981-15-3266-5 (eBook) https://doi.org/10.1007/978-981-15-3266-5

© Springer Nature Singapore Pte Ltd. 2020

This work is subject to copyright. All rights are reserved by the Publisher, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, reuse of illustrations, recitation, broadcasting, reproduction on microfilms or in any other physical way, and transmission or information storage and retrieval, electronic adaptation, computer software, or by similar or dissimilar methodology now known or hereafter developed.

The use of general descriptive names, registered names, trademarks, service marks, etc. in this publication does not imply, even in the absence of a specific statement, that such names are exempt from the relevant protective laws and regulations and therefore free for general use.

The publisher, the authors and the editors are safe to assume that the advice and information in this book are believed to be true and accurate at the date of publication. Neither the publisher nor the authors or the editors give a warranty, expressed or implied, with respect to the material contained herein or for any errors or omissions that may have been made. The publisher remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

This Springer imprint is published by the registered company Springer Nature Singapore Pte Ltd. The registered company address is: 152 Beach Road, #21-01/04 Gateway East, Singapore 189721, Singapore

Contents

1	Introduction	1
2	Molecular and Cellular Functions of CTLA-4 Samya Van Coillie, Bartosz Wiernicki and Jie Xu	7
3	Roles of PD-1/PD-L1 Pathway: Signaling, Cancer,and BeyondLuoyan Ai, Antao Xu and Jie Xu	33
4	Discovery of New Immune Checkpoints: Family Grows Up Xuan Kong	61
5	Mechanisms of Resistance to Checkpoint Blockade Therapy Hubing Shi, Jiang Lan and Jiqiao Yang	83
6	Molecular Events Behind Adverse Effects	119
7	Rational Discovery of Response Biomarkers: Candidate Prognostic Factors and Biomarkers for Checkpoint	
	Inhibitor-Based Immunotherapy Qianqian Hou and Heng Xu	143
8	Spatiotemporal Changes in Checkpoint Molecule Expression Wenhua Li, Jingbo Qie, Yao Zhang and Jinjia Chang	167
9	Functions of Immune Checkpoint Molecules Beyond Immune Evasion	201
10	Genetic Alterations and Checkpoint Expression:Mechanisms and Models for Drug DiscoveryShuai Ding, Siqi Li, Shujie Zhang and Yan Li	227

11	Regulations on Messenger RNA: Wires and Nodes Jean-Philippe Brosseau	251
12	Folded or Degraded in Endoplasmic Reticulum Chushu Li, Bingqing Xia, Sheng Wang and Jie Xu	265
13	Regulation of Cancer Immune Checkpoint:Mono- and Poly-Ubiquitination: Tags for FateHan Yao and Jie Xu	295
14	Lysosome as the Black Hole for Checkpoint Molecules Huanbin Wang, Xue Han and Jie Xu	325
15	Phosphorylation: A Fast Switch For Checkpoint Signaling Yiting Wang, Ping Wang and Jie Xu	347
16	Palmitoylation as a Signal for DeliveryYiting Wang, Haojie Lu, Caiyun Fang and Jie Xu	399
17	Methodology for Detecting Protein Palmitoylation Haojie Lu and Caiyun Fang	425
18	Checkpoints Under Traffic Control: From and to Organelles Shouyan Deng, Xiaolin Zhou and Jie Xu	431
19	Exosome and Secretion: Action On?	455
20	Macromolecules and Antibody-Based Drugs	485
21	Mechanisms Inspired Targeting Peptides	531
22	Small Molecular Immune Modulators as Anticancer Agents Yongxin Han, Li Zhu, Wei Wu, Hui Zhang, Wei Hu, Liguang Dai and Yanqing Yang	547
23	Therapeutic Development of Immune Checkpoint Inhibitors Jilin Wang, Teddy Yang and Jie Xu	619
24	Concluding Remarks Jie Xu and Mingyao Liu	651

Contributors

Luoyan Ai Department of Medical Oncology, Zhongshan Hospital, Fudan University, Shanghai, China

Jean-Philippe Brosseau Department of Biochemistry and functional Genomics, University of Sherbrooke, Sherbrooke, Canada

Jinjia Chang Department of Medical Oncology, Fudan University Shanghai Cancer Center, Shanghai, China

Gang Chen The State Key Laboratory Breeding Base of Basic Science of Stomatology (Hubei-MOST) & Key Laboratory of Oral Biomedicine of Ministry of Education, School and Hospital of Stomatology, Wuhan University, Wuhan, People's Republic of China

Liguang Dai PrimeGene (Beijing) Co., Ltd., Beijing, China

Shouyan Deng Renji Hospital, School of Medicine, Shanghai Jiao Tong University, Shanghai, China

Shuai Ding The State Key Laboratory of Pharmaceutical Biotechnology and MOE Key Laboratory of Model Animals for Disease Study, Department of Rheumatology and Immunology, the Affiliated Drum Tower Hospital of Nanjing University Medical School, Model Animal Research Center of Nanjing University, Nanjing, Jiangsu, China

Caiyun Fang Department of Chemistry, Institutes of Biomedical Sciences, Fudan University, Shanghai, China

Xue Han Institutes of Biological Sciences, Fudan University, Shanghai, China

Yongxin Han Lapam Capital LLC., Beijing, China

Qianqian Hou Department of Laboratory Medicine, Precision Medicine Center, State Key Laboratory of Biotherapy, West China Hospital, Sichuan University, Chengdu, China Wei Hu PrimeGene (Beijing) Co., Ltd., Beijing, China

Ye Hu Department of Gastroenterology, Xinhua Hospital, Shanghai Jiao Tong University School of Medicine, Shanghai, China;

Women's Cancer Program, Samuel Oschin Comprehensive Cancer Institute, Cedars-Sinai Medical Center, Los Angeles, CA, USA

Xuan Kong Bristol Myers Squibb Global Clinical Research, Shanghai, China

Jiang Lan The State Key Laboratory of Biotherapy, Sichuan University West China Hospital, Chengdu, China

Chushu Li Renji Hospital, Shanghai Jiao Tong University, Shanghai, China

Siqi Li The State Key Laboratory of Pharmaceutical Biotechnology and MOE Key Laboratory of Model Animals for Disease Study, Department of Rheumatology and Immunology, the Affiliated Drum Tower Hospital of Nanjing University Medical School, Model Animal Research Center of Nanjing University, Nanjing, Jiangsu, China

Wenhua Li Department of Medical Oncology, Fudan University Shanghai Cancer Center, Shanghai, China

Yan Li The State Key Laboratory of Pharmaceutical Biotechnology and MOE Key Laboratory of Model Animals for Disease Study, Department of Rheumatology and Immunology, the Affiliated Drum Tower Hospital of Nanjing University Medical School, Model Animal Research Center of Nanjing University, Nanjing, Jiangsu, China

Jie Liu Department of Digestive Diseases, Huashan Hospital, Fudan University, Shanghai, China;

Department of Immunology, State Key Laboratory of Genetic Engineering, Institutes of Biomedical Sciences, Fudan University, Shanghai, China

Mingyao Liu Institute of Biomedical Sciences and School of Life Sciences, East China Normal University, Shanghai, China

Haojie Lu Department of Chemistry, Institutes of Biological Sciences, Fudan University, Shanghai, China

Jingbo Qie Institutes of Biomedical Sciences, Fudan University, Shanghai, China

Hubing Shi The State Key Laboratory of Biotherapy, Sichuan University West China Hospital, Chengdu, China

Yao Shuai Biomedical Pioneering Innovation Center (BIOPIC), School of Life Sciences, Peking University, Beijing, China

Xiao-Dong Su Biomedical Pioneering Innovation Center (BIOPIC), School of Life Sciences, Peking University, Beijing, China

Shan Sun Department of Immunology and Microbiology, Shanghai Institute of Immunology, Shanghai Jiao Tong University School of Medicine, Shanghai, China; Research Center of Translational Medicine, Shanghai Children's Hospital, Shanghai Jiao Tong University School of Medicine, Shanghai, China

Samya Van Coillie Molecular Signaling and Cell Death Unit, VIB-UGent Center for Inflammation Research, Ghent, Belgium

Feng Wang Department of Immunology and Microbiology, Shanghai Institute of Immunology, Shanghai Jiao Tong University School of Medicine, Shanghai, China; Research Center of Translational Medicine, Shanghai Children's Hospital, Shanghai Jiao Tong University School of Medicine, Shanghai, China

Huanbin Wang School of Medicine, Renji Hospital, Shanghai Jiao Tong University, Shanghai, China

Jilin Wang Renji Hospital, School of Medicine, Shanghai Jiao Tong University, Shanghai Institute of Digestive Disease, Shanghai, China

Ping Wang Shanghai Tenth People's Hospital of Tongji University, School of Medicine, School of Life Sciences and Technology, Tongji University Cancer Center, Tongji University, Shanghai, China

Sheng Wang Institutes of Biomedical Sciences, Fudan University, Shanghai, China

Yiting Wang School of Medicine, Renji Hospital, Shanghai Jiao Tong University, Shanghai, China

Bartosz Wiernicki Molecular Signaling and Cell Death Unit, VIB-UGent Center for Inflammation Research, Ghent, Belgium

Wei Wu PrimeGene (Beijing) Co., Ltd., Beijing, China

Bingqing Xia Shanghai Institute of Materia Medica, Chinese Academy of Sciences, Shanghai, China

Antao Xu Department of Rheumatology, Renji Hospital, Shanghai Jiaotong University, Shanghai, China

Heng Xu Department of Laboratory Medicine, Precision Medicine Center, State Key Laboratory of Biotherapy, West China Hospital, Sichuan University, Chengdu, China

Jie Xu Institutes of Biomedical Sciences, Zhongshan-Xuhui Hospital, Fudan University, Shanghai, China

Jiqiao Yang The State Key Laboratory of Biotherapy, Sichuan University West China Hospital, Chengdu, China

Teddy Yang Biologics Discovery, Shanghai ChemPartner Co., Ltd., Shanghai, China

Yanqing Yang PrimeGene (Beijing) Co., Ltd., Beijing, China

Han Yao Renji Hospital, Shanghai Jiao Tong University, Shanghai, China

Yunsheng Yuan School of Pharmacy, Engineering Research Center of Cell and Therapeutic Antibody, Ministry of Education, Shanghai Jiao Tong University, Shanghai, China

Hui Zhang PrimeGene (Beijing) Co., Ltd., Beijing, China

Rui Zhang Department of Cardiology, Xinhua Hospital, Shanghai Jiao Tong University School of Medicine, Shanghai, China; Smidt Heart Institute, Cedars-Sinai Medical Center, Los Angeles, CA, USA

Shujie Zhang The State Key Laboratory of Pharmaceutical Biotechnology and MOE Key Laboratory of Model Animals for Disease Study, Department of Rheumatology and Immunology, the Affiliated Drum Tower Hospital of Nanjing University Medical School, Model Animal Research Center of Nanjing University, Nanjing, Jiangsu, China

Yao Zhang Department of Medical Oncology, Fudan University Shanghai Cancer Center, Shanghai, China

Yaping Zhang Hongqiao International Institute of Medicine, Shanghai Tongren Hospital, Key Laboratory of Cell Differentiation and Apoptosis of Chinese Ministry of Education, Faculty of Basic Medicine, Shanghai Jiao Tong University School of Medicine, Shanghai, China

Junke Zheng Hongqiao International Institute of Medicine, Shanghai Tongren Hospital, Key Laboratory of Cell Differentiation and Apoptosis of Chinese Ministry of Education, Faculty of Basic Medicine, Shanghai Jiao Tong University School of Medicine, Shanghai, China

Xiaolin Zhou Department of Neurology, Shanghai General Hospital, Shanghai Jiao Tong University School of Medicine, Shanghai, People's Republic of China

Li Zhu PrimeGene (Beijing) Co., Ltd., Beijing, China