

中国免疫学杂志 二〇二三年 第三十九卷 第七期



中文核心期刊
中国科技核心期刊
RCCSE 中国核心学术期刊
中国科学引文数据库来源期刊

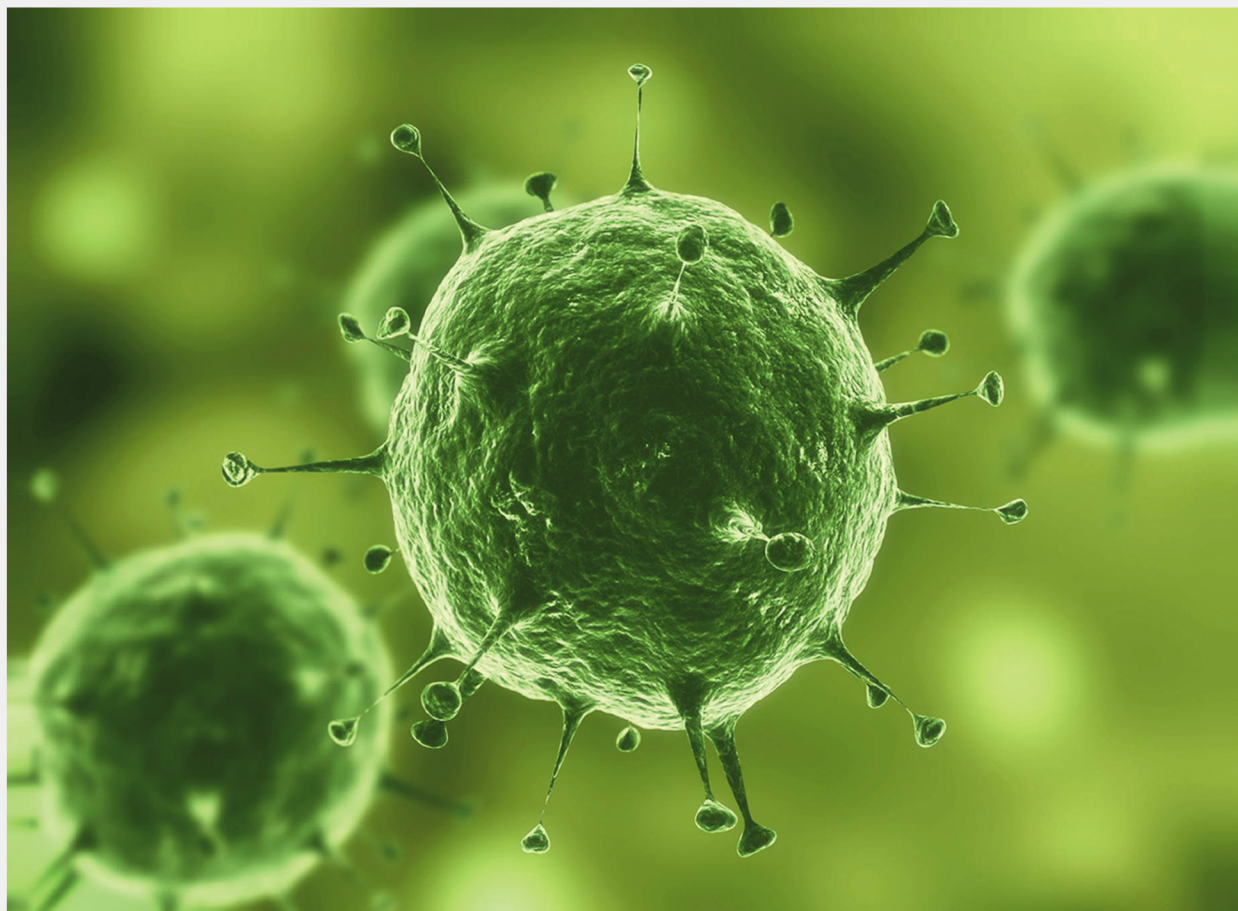
ISSN 1000-484X
CN 22-1126/R



Chinese Journal of Immunology

中国免疫学杂志®

ZHONG GUO MIAN YI XUE ZA ZHI



ISSN 1000-484X



中国免疫学会会刊

2023

7

July 2023

第39卷 第7期

Volume 39 Number 7

中国免疫学杂志

Zhongguo Mianyixue Zazhi

月刊 1985 年 1 月创刊 第 39 卷 第 7 期 2023 年 7 月 10 日出版

主 管

中国科学技术协会

主 办

中国免疫学会

100005,北京市东单三条5号

吉林省医学期刊社

130061,长春市建政路971号

编 辑

中国免疫学杂志编辑委员会

130061,长春市建政路971号

电话(传真):(0431)88925027

E-mail:zhmizazh@126.com

网址:www.immune99.com

www.中国免疫学.中国

主 编

田志刚

编辑部主任

张晓舟

责任编辑

陈 阳 周文瑜

出 版

中国免疫学杂志编辑部

130061,长春市建政路971号

电话:(0431)88925027

印 刷

吉林方鼎印业有限公司

发 行

国内:中国邮政集团有限公司

长春市分公司

国外:中国国际图书贸易集团

有限公司

(北京399信箱,100044)

代号 M6689

订 阅

全国各地邮局

邮发代号 12-89

邮 购

中国免疫学杂志编辑部

130061,长春市建政路971号

电话(传真):(0431)88925027

E-mail:zhmizazh@126.com

定 价(国内)

单价36.00元,全年432.00元

中国标准连续出版物号

ISSN 1000-484X

CN 22-1126/R

广告发布已获吉林省市场

监督管理局许可

如有印装质量问题,请向编辑部调换

目 次

论 著

基础免疫学

BET蛋白抑制剂JQ1对MRL/lpr狼疮小鼠外周B细胞分化的影响

曾 珊 肖游君 邱 茜 李 昊 徐思琪 王竞男 1345

石茂华 梁柳琴 许韩师

多聚甲醛固定DIO染色外泌体对肿瘤细胞活性的影响 1351

刘佳敏 杨艳红 彭 彬 戴 敏 徐 旭 张自力

曾 蓉 潘万龙

外源性白介素17A激活PLC/PRF/5细胞内PI3K/AKT信号转导

通路抑制HBsAg表达的研究 1358

杨 凯 潘 颖 宇芙蓉 张发苏 陈 谨 严家来

张 浩 施 维

基于Keap1/Nrf2/NLRP3炎症小体和p62途径探讨右美托咪定

改善脑卒中后损伤的内在机制 1362

高 毅 冷玉芳 张保朝 司小萌 温昌明 孙 丽

孙 军 张 萌 李 刚 司海超 张新科 刘 展

王 飒

乳腺癌铁死亡相关lncRNA预后模型构建和功能探索 1367

时珊珊 葛丽丽 李玉宏

雷帕霉素诱导肺血管内皮通透性增加促进小鼠肺部炎症的探讨

1374

陈小林 陈建辉 李先凡 余增谱

基于生物信息学分析腹膜透析腹膜细胞的免疫相关基因差异

表达 1379

吴泽归 黄国海 曲廖准

基于Notch信号通路探讨柚皮素调节Th17/Treg平衡治疗哮喘的

机制研究 1383

陈 雪 石亚琳 孙合圣 李海艳 宋延刚

芒果苷对CCI大鼠神经病理性疼痛的改善作用 1390

李国良 杨晓春 宏 杰 高玉峰

期刊基本参数:CN22-1126/R * 1985 * m * A4 * 224 * zh * P * 36.00 * 1200 * 41 * 2023-7 * n

基于p38MAPK/SERCA2 α 通路观察羟基红花黄色素A对大鼠心肌缺血/再灌注损伤的保护作用	1395
于 华 曲 莉	
miR-22-3p靶向NLRP3表达对脑缺血再灌注损伤大鼠细胞焦亡的影响	1402
李利超 王少博 程 艳 王 莉	
下调lncRNA NEAT1通过NF- κ B信号传导途径抑制TNF- α 诱导的肺泡上皮细胞A549氧化损伤 和炎症因子释放	1409
邱光钰 曹锋生 黄 敏 黄远东 唐丹丹	
中医中药与免疫	
姜黄素联合顺铂调控PI3K/Akt信号通路对卵巢癌耐药细胞增殖、迁移和凋亡的影响	1415
余 瑛 张群贵 崔华子 廖振蓉 王 琪 彭 涛	
甘草酮A通过调节mTOR/HIF-1 α 途径对顺铂诱导的肾小管上皮细胞的保护作用机制	1420
吴若霞 田 莎 熊家青 田雪飞 黄新艳	
柴胡皂苷D对2型糖尿病大鼠胰岛素抵抗及FoxO1/PGC-1 α 通路的影响	1425
宋 萍 纳 娜 王 燕	
香青藤提取物通过Wnt/ β -catenin信号通路抑制胶质瘤U87细胞的间质转化	1431
韦 洁 李冬梅 何俊慧 韦冬梅 李 懿 何 飞 韦桂宁	
排毒保肾丸对糖尿病肾病大鼠炎症小体NLRP3表达及NF- κ B信号通路的影响	1437
李 敬 乔丽丽 张丽敏 高 燕 樊 星 田 领	
肿瘤免疫学	
肝癌细胞自分泌外泌体通过TGF- β 1调控自身细胞学行为	1442
李文华 王芊文 王小芳 赵 彬 耿玉庆 曹明珍 吴向未 陈雪玲	
CXCL12/CXCR4轴通过调节自噬促进乳腺癌细胞对多柔比星的化疗抗性	1446
李 霞 梁海珊 程 学 段 哲	
基于WGCNA构建食管鳞癌免疫相关基因预后模型	1452
胡海洋 张 俊 刘 涛 周海宁	
装载阿霉素和GM-CSF的纳米颗粒增强宫颈癌抗肿瘤免疫反应的研究	1457
张贤雨 马 欢 席 强 张志林	
COX-2在食管鳞癌放疗前后的表达变化及其对免疫微环境的影响	1463
吴 越 刘馨博 卢开进 戴春雷 孙光志 王 鹏 沈小舟 李祎萍 韩高华	
STING激动剂联合PD-1抗体通过激活T细胞的抗肿瘤活性抑制肺癌进展的研究	1469
张西科 杨建彬 邵鸿飞 康利娜 刘艳玲 刘 杰	
临床免疫学	
艰难梭菌感染者血清CCL7的表达及意义研究	1474
余仁琳 刘家宇 陈彦青 陈 特 曹 炬	
补阳还五汤联合尤瑞克林对急性脑梗死患者免疫功能及血液流变学的影响	1481
张振帅 周 欣 鲁海琴	
血浆免疫吸附治疗难治性急性痛风性关节炎临床研究	1486
周蓓蓓 魏 华 贾捷婷 张学翔 郁新迪 周 萌	
胸腺基质淋巴细胞生成素联合小气道肺功能指标诊断儿童咳嗽变异性哮喘的临床价值	1490
晁 婵	
免疫学技术与方法	
两种心衰标志物荧光免疫层析联合检测技术研究	1494
魏治静 裴晓萌 宋温婷 侯亚璐 王 静 柳峰松 赵梅红 吴 萌	

冻干鼻喷流感减毒活疫苗病毒滴度FFA法的建立及验证	1500
贾伟 支百慧 韩玲 朱大永 王荣 张春 赵慧 刘大维	

教学园地

后疫情时期医学免疫学课程思政融入的思考和探索	1507
赵娟娟 郭萌萌 周涯 徐德林 郑静 覃明 徐林	
以目标感带动自主和团队学习相结合:医学免疫学教学设计、实践与反思	1513
任欢 李强 张政	
虚拟仿真实验在炭疽实验室诊断及皮毛检疫实验中的应用	1516
唐峰 唐雨顺 刘永华 王书全 刘秀萍 寇叙	

综述

肿瘤相关中性粒细胞在肿瘤免疫治疗中的研究进展	1519
陈晓琳 杨于权 侯照远 贾浩	
系统性红斑狼疮患者内源性激素对免疫系统的影响	1525
张莹莹 束庆 葛佳佳 葛卫红	
sIgA在抗病毒治疗中的研究进展	1532
黄碧莲 吴喜林 吴稚伟	
调控巨噬细胞极化影响创面愈合的因素及机制分析	1538
程一凡 殷玉莲 陈红凤	
BCMA CAR-T细胞调节骨髓瘤长期免疫应答的研究进展	1543
曾子安 周玉生 匡双玉 徐晓芳	
肠道菌群与风湿病关系及中医药调节作用的研究进展	1549
徐晓宇 李延萍 戴敏 吴斌 唐嘉琪	
ctDNA与免疫治疗相关的假性进展和超进展	1554
韩叶 吴重阳 宋颖 金祺祺 蒋皓云 柴晔 曾鹏云 岳玲玲	
$\alpha 7$ 烟碱型乙酰胆碱受体在单核/巨噬细胞介导的炎症反应与极化调控中的作用	1561
陈玲 张虹 郑长伟 谢凤杰	
Torque teno病毒评估移植免疫功能的研究进展	1566
郑仲征 李岱阳 杜可明 徐祥 王宁娟 袁志阳	

《中国免疫学杂志》第九届编辑委员会名单	封二
---------------------------	----

声明

启事



本期审稿人名单

(按姓氏拼音字母顺序排列)

陈玮琳	崔天盆	冯健男	侯娟娟	黄丰	黄河	焦新安	李明成
李霞	李湘奇	李一	吕仕超	马存根	钱程	任秀宝	沈燕
石桂秀	石艳春	孙阳	唐超智	王吉波	王健	王金岩	王锦鸿
王仁喜	王伟	向明	徐鹏程	徐涛	叶韵斌	余平	张冬青
张建全	张军平	张文峰	卓孝福	邹和建			

Chinese Journal of Immunology

Monthly Established in January 1985

Volume 39 Number 7, July 10, 2023

Responsible Institution

China Association for Science and
Technology

Sponsor

Chinese Society of Immunology
5, Dongdan Santiao, Beijing 100005,
China
Medical Periodical Society of Jilin
971, Jianzheng Road, Changchun
130061, China

Editing

Editorial Board of Chinese Journal of
Immunology
971, Jianzheng Road, Changchun
130061, China
Tel(Fax): (86-431)88925027
E-mail: zhminzazh@126.com
Web. site: www.immune99.com
www. 中国免疫学. 中国

Editor-in-Chief

TIAN Zhigang(田志刚)

Managing Director

ZHANG Xiaozhou(张晓舟)

Executive Editor

CEN Yang(陈阳)
ZHOU Wenyu(周文瑜)

Publishing

Editorial Board of Chinese Journal
of Immunology
971, Jianzheng Road, Changchun
130061, China
Tel: (86-431)88925027

Printing

Jilin Fangding Printing Limited
Corporation

Distributor

Domestic Distributor:
Changchun Branch of China
Post Group Corporation Limited
Overseas Distributor:
China International Book
Trade Group Co. LTD
(P. O. Box 399, Beijing, P. R. China)
Code No. M6689

Subscribing

Local Post Office in China
Issue Code 12-89

Mail-Order

Editorial Board of Chinese Journal of
Immunology
971, Jianzheng Road, Changchun
130061, China
Tel: (86-431) 88925027
E-mail: zhminzazh@126.com

CSSN

ISSN 1000-484X
CN 22-1126/R

CONTENTS IN BRIEF

RESEARCH ARTICLES

BASIC IMMUNOLOGY

- Effect of BET inhibitor JQ1 on peripheral B cell differentiation of MRL/lpr lupus mice
..... 1345
*ZENG Shan, XIAO Youjun, QIU Qian, LI Hao, XU Siqi, WANG Jingnan,
SHI Maohua, LIANG Liuqin, XU Hanshi*
- Effect of paraformaldehyde fixed DIO stained exosomes on tumor cell activity 1351
*LIU Jiamin, YANG Yanhong, PENG Bin, JI Min, XU Xu, ZHANG Zili,
ZENG Rong, PAN Wanlong*
- Exogenous interleukin 17A activates PI3K/AKT signal transduction pathway in
PLC/PRF/5 cells to inhibit HBsAg expression 1358
*YANG Kai, PAN Ying, YU Furong, ZHANG Fasuo, CHEN Jin, YAN Jialai,
ZHANG Hao, SHI Wei*
- Mechanism of dexmedetomidine in improving post-stroke injury based on Keap1/
Nrf2/NLRP3 inflammasome and p62 pathways 1362
*GAO Yi, LENG Yufang, ZHANG Baochao, SI Xiaomeng, WEN Changming,
SUN Li, SUN Jun, ZHANG Meng, LI Gang, SI Haichao, ZHANG Xinke,
LIU Zhan, WANG Sa*
- Establishment and functional exploration of ferroptosis-related lncRNA prognosis
model for breast cancer 1367
SHI Shanshan, GE Lili, LI Yuhong
- Study on rapamycin-induced pulmonary vascular endothelial hyperper-meability
and lung inflammation in mice 1374
CHEN Xiaolin, CHEN Jianhui, LI Xianfan, YU Zengpu
- Differentially expressed immune related genes of peritoneal cells in patients with
peritoneal dialysisby bioinformatics 1379
WU Zegui, HUANG Guohai, QU Liaoqun
- Mechanism of naringenin in regulating Th17/Treg balance to treat asthma based on
Notch signaling pathway 1383
CHEN Xue, SHI Yalin, SUN Hesheng, LI Haiyan, SONG Yangang
- Improvement effect of mangiferin on neuropathic pain in CCI rats 1390
LI Guoliang, YANG Xiaochun, HONG jie, GAO Yufeng
- Protective effect of hydroxysafflor yellow A on myocardial ischemia/reperfusion
injury in rats based on p38MAPK/SERCA2 α pathway 1395
YU Hua, QU Li
- Effect of miR-22-3p on pyroptosis of cerebral ischemia-reperfusion injury rats via
targeting expression of NLRP3 1402
LI Lichao, WANG Shaobo, CHENG Yan, WANG Li

Down-regulation of lncRNA NEAT1 inhibits TNF- α -induced oxidative damage and inflammatory factors release in alveolar epithelial cells A549 through NF- κ B signaling pathway	1409
<i>QIU Guangyu, CAO Fengsheng, HUANG Min, HUANG Yuandong, TANG Dandan</i>	

CHINESE TRADITIONAL MEDICINE AND IMMUNOLOGY

Effect of curcumin combined with cisplatin on PI3K/Akt signaling pathway on proliferation, migration and apoptosis of drug-resistant ovarian cancer cells	1415
<i>YU Ying, ZHANG Qungui, CUI Huazi, LIAO Zhenrong, WANG Qi, PENG Tao</i>	
Protective mechanism of Licochalcone A on cisplatin induced renal tubular epithelial cells by regulating mTOR/HIF-1 α pathway	1420
<i>WU Ruoxia, TIAN Sha, XIONG Jiaqing, TIAN Xuefei, HUANG Xinyan</i>	
Effects of saikosaponin D on insulin resistance and FoxO1/PGC-1 α pathway in type 2 diabetic rats	1425
<i>SONG Ping, NA Na, WANG Yan</i>	
Extract of <i>Illigera aromatic</i> inhibited interstitial transformation of glioblastoma U87 cells through Wnt/ β -catenin signaling pathway	1431
<i>WEI Jie, LI Dongmei, HE Junhui, WEI Dongmei, LI Yi, HE Fei, WEI Guining</i>	
Effect of Paidu Baoshen Pill on expression of inflammatory bodies NLRP3 and NF- κ B signaling pathway in rats with diabetic kidney disease	1437
<i>LI Jing, QIAO Lili, ZHANG Limin, GAO Yan, FAN Xing, TIAN Ling</i>	

TUMOR IMMUNOLOGY

Autocrine exosomes in liver cancer cells are regulated by TGF- β 1 autologous cell behavior	1442
<i>LI Wenhua, WANG Qianwen, WANG Xiaofang, ZHAO Bin, GENG Yuqing, CAO Mingzhen, WU Xiangwei, CHEN Xueling</i>	
CXCL12/CXCR4 axis promotes chemotherapy resistance of breast cancer cells to doxorubril by regulating autophagy	1446
<i>LI Xia, LIANG Haishan, CHENG Xue, DUAN Zhe</i>	
Development of a prognostic model of immune-related genes for esophageal squamous cell carcinoma based on WGCNA	1452
<i>HU Haiyang, ZHANG Jun, LIU Tao, ZHOU Haining</i>	
Nanoparticles loaded with adriamycin and GM-CSF enhance anti-tumor immune response of cervical cancer	1457
<i>ZHANG Xianyu, MA Huan, XI Qiang, ZHANG Zhilin</i>	
Expression changes of COX-2 in esophageal squamous cell carcinoma before and after radiotherapy and its effect on immune microenvironment	1463
<i>WU Yue, LIU Xinbo, LU Kaijin, DAI Chunlei, SUN Guangzhi, WANG Peng, SHEN Xiaozhou, LI Yiping, HAN Gaohua</i>	
STING agonist combined with PD-1 antibody inhibits lung cancer progression by activating antitumor activity of T cells	1469
<i>ZHANG Xike, YANG Jianbin, SHAO Hongfei, KANG Lina, LIU Yanling, LIU Jie</i>	

CLINICAL IMMUNOLOGY

Study of expression and significance of CCL7 in serum in <i>Clostridium difficile</i> patients	1474
<i>YU Renlin, LIU Jiayu, CHEN Yanqing, CHEN Te, CAO Ju</i>	
Effect of Buyang Huanwu Decoction combining with urikalin on immune function and hemorheology in patients with acute cerebral infarction	1481
<i>ZHANG Zhenshuai, ZHOU Xin, LU Haiqin</i>	
Clinical study of plasma adsorption in treatment of refractory acute gouty arthritis	1486
<i>ZHOU Beibei, WEI Hua, JIA Jieting, ZHANG Xuexiang, YU Xindi, ZHOU Meng</i>	
Clinical value of thymic stromal lymphopoietin combined with small airway lung function indexes in the diagnosis of cough variant asthma in children	1490
<i>CHAO Chan</i>	

IMMUNOLOGICAL TECHNIQUE AND METHOD

Study on fluorescence immunochromatography for combined detection of two heart failure biomarkers	1494
<i>WEI Zhiqing, PEI Xiaomeng, SONG Wenting, HOU Yalu, WANG Jing, LIU Fengsong, ZHAO Meihong, WU Meng</i>	

Development and validation of FFA method for virus titer detection of freeze-dried nasal spray live attenuated influenza vaccine	1500
<i>JIA Wei, ZHI Baihui, HAN Ling, ZHU Dayong, WANG Rong, ZHANG Chun, ZHAO Hui, LIU Dawei</i>	

TEACHING FIELD

Consideration and exploration of integrating ideological and political education into Medical Immunology in post-epidemic era ...	1507
<i>ZHAO Juanjuan, GUO Mengmeng, ZHOU Ya, XU Delin, ZHENG Jing, QIN Ming, XU Lin</i>	
Objective-driven self-learning combined with team-learning in Medical Immunology teaching: Design, practice and reflection ...	1513
<i>REN Huan, LI Qiang, ZHANG Zheng</i>	
Application of virtual simulation experiment in anthrax laboratory diagnosis and fur anthrax quarantine experiment	1516
<i>TANG Feng, TANG Yushun, LIU Yonghua, WANG Shuquan, LIU Xiuping, KOU Xu</i>	

REVIEW

Role of tumor-associated neutrophils in tumor immunotherapy	1519
<i>CHEN Xiaolin, YANG Yuquan, HOU Zhaoyuan, JIA Hao</i>	
Effect of hormones on immune system in patients with systemic lupus erythematosus	1525
<i>ZHANG Yingying, SHU Qing, GE Jiajia, GE Weihong</i>	
Research progress of sIgA in antiviral therapy	1532
<i>HUANG Bilian, WU Xilin, WU Zhiwei</i>	
Factors and mechanism of regulating macrophage polarization affecting wound healing	1538
<i>CHENG Yifan, YIN Yulian, CHEN Hongfeng</i>	
Progress of BCMA targeted CAR-T cells regulating long-term immune reaction in multiple myeloma	1543
<i>ZENG Zi'an, ZHOU Yusheng, KUANG Shuangyu, XU Xiaofang</i>	
Research progress on relationship between intestinal flora and rheumatism and regulating effect of traditional Chinese medicine	1549
<i>XU Xiaoyu, LI Yanping, DAI Min, WU Bin, TANG Jiaqi</i>	
ctDNA and immunotherapy-related pseudoprogression and hyperprogression	1554
<i>HAN Ye, WU Chongyang, SONG Ying, JIN Qiqi, JIANG Haoyun, CHAI Ye, ZENG Pengyun, YUE Lingling</i>	
Role of alpha7 nicotinic acetylcholine receptor in monocytes/macrophages-mediated inflammation responses and polarization regulation	1561
<i>CHEN Ling, ZHANG Hong, ZHENG Changwei, XIE Fengjie</i>	
Progress of <i>Torque teno</i> virus in evaluating transplant immune function	1566
<i>ZHENG Zhongzheng, LI Daiyang, DU Keming, XU Xiang, WANG Ningjuan, YUAN Zhiyang</i>	

- 2018,9:686. DOI:10.3389/fmicb.2018.00686.
- [24] FRYE B C, BIERBAUM S, FALCONE V, *et al.* Kinetics of Torque Teno virus-DNA plasma load predict rejection in lung transplant recipients [J]. *Transplantation*, 2019, 103 (4) : 815-822. DOI:10.1097/TP.0000000000002436.
 - [25] SCHIEMANN M, PUCHHAMMER-STÖCKL E, ESKANDARY F, *et al.* Torque Teno virus load-inverse association with antibody-mediated rejection after kidney transplantation [J]. *Transplantation*, 2017, 101 (2) : 360-367. DOI: 10.1097/TP.0000000000001455.
 - [26] GORZER I, HALOSCHAN M, JAKSCH P, *et al.* Plasma DNA levels of Torque teno virus and immunosuppression after lung transplantation [J]. *J Heart Lung Transplant*, 2014, 33 (3) : 320-323. DOI:10.1016/j.healun.2013.12.007.
 - [27] GORZER I, JAKSCH P, STRASSL R, *et al.* Association between plasma Torque teno virus level and chronic lung allograft dysfunction after lung transplantation [J]. *J Heart Lung Transplant*, 2017, 36 (3) : 366-368. DOI: 10.1016/j.healun.2016.10.011.
 - [28] HALOSCHAN M, BETTESCH R, GORZER I, *et al.* TTV DNA plasma load and its association with age, gender, and HCMV IgG serostatus in healthy adults [J]. *Age (Dordr)*, 2014, 36 (5) : 9716. DOI: 10.1007/s11357-014-9716-2.
 - [29] WOHLFARTH P, LEINER M, SCHOERGENHOFER C, *et al.* Torque teno virus dynamics and immune marker properties in patients following allogeneic hematopoietic stem cell transplantation: A prospective longitudinal study [J]. *Biol Blood Marrow Transplant*, 2018, 24 (1) : 194-199. DOI: 10.1016/j.bbmt.2017.09.020.
 - [30] STRASSL R, SCHIEMANN M, DOBERER K, *et al.* Quantification of Torque Teno virus viremia as a prospective biomarker for infectious disease in kidney allograft recipients [J]. *J Infect Dis*, 2018, 218 (8) : 1191-1199. DOI: 10.1093/infdis/jiy306.
 - [31] FERNANDEZ-RUIZ M, ALBERT E, GIMENEZ E, *et al.* Monitoring of alphatorquevirus DNA levels for the prediction of immunosuppression-related complications after kidney transplantation [J]. *Am J Transplant*, 2019, 19 (4) : 1139-1149. DOI: 10.1111/ajt.15145.
 - [32] STRASSL R, DOBERER K, RASOUL-ROCKENSCHAUB S, *et al.* Torque Teno virus for risk stratification of acute biopsy-proven alloreactivity in kidney transplant recipients [J]. *J Infect Dis*, 2019, 219 (12) : 1934-1939. DOI: 10.1093/infdis/jiz039.
 - [33] SOLIS M, VELAY A, GANTNER P, *et al.* Torquetenovirus viremia for early prediction of graft rejection after kidney transplantation [J]. *J Infect*, 2019, 79 (1) : 56-60. DOI: 10.1016/j.jinf.2019.05.010.
 - [34] BURRA P, MASIER A, BOLDRIN C, *et al.* Torque Teno virus: Any pathological role in liver transplanted patients? [J]. *Transpl Int*, 2008, 21 (10) : 972-979. DOI: 10.1111/j.1432-2277.2008.00714.x.
 - [35] NORDEN R, MAGNUSSON J, LUNDIN A, *et al.* Quantification of Torque Teno virus and Epstein-Barr virus is of limited value for predicting the net state of immunosuppression after lung transplantation [J]. *Open Forum Infect Dis*, 2018, 5 (4) : y50. DOI: 10.1093/ofid/ofy050.
 - [36] MAGGI F, PISTELLO M, VATTERONI M, *et al.* Dynamics of persistent TT virus infection, as determined in patients treated with alpha interferon for concomitant hepatitis C virus infection [J]. *J Virol*, 2001, 75 (24) : 11999-12004. DOI: 10.1128/JVI.75.24.11999-12004.2001.
 - [37] FOCOSI D, ANTONELLI G, PISTELLO M, *et al.* Torquetenovirus: The human virome from bench to bedside [J]. *Clin Microbiol Infect*, 2016, 22 (7) : 589-593. DOI: 10.1016/j.cmi.2016.04.007.
 - [38] MANKOTIA D S, IRSHAD M. Cloning and expression of N22 region of Torque Teno virus (TTV) genome and use of peptide in developing immunoassay for TTV antibodies [J]. *Virol J*, 2014, 11:96. DOI: 10.1186/1743-422X-11-96.
 - [39] ITOH Y, TAKAHASHI M, FUKUDA M, *et al.* Visualization of TT virus particles recovered from the sera and feces of infected humans [J]. *Biochem Biophys Res Commun*, 2000, 279 (2) : 718-724. DOI: 10.1006/bbrc.2000.4013.
 - [40] FOCOSI D, MACERA L, PISTELLO M, *et al.* Torque Teno virus viremia correlates with intensity of maintenance immunosuppression in adult orthotopic liver transplant [J]. *J Infect Dis*, 2014, 210 (4) : 667-668. DOI: 10.1093/infdis/jiu209.
 - [41] FOCOSI D, MACERA L, BOGGI U, *et al.* Short-term kinetics of torque teno virus viraemia after induction immunosuppression confirm T lymphocytes as the main replication-competent cells [J]. *J Gen Virol*, 2015, 96 (Pt 1) : 115-117. DOI: 10.1099/vir.0.070094-0.
 - [42] MAGGI F, RICCI V, BENDINELLI M, *et al.* Changes in CD8⁺57⁺ T lymphocyte expansions after autologous hematopoietic stem cell transplantation correlate with changes in torquetenovirus viremia [J]. *Transplantation*, 2008, 85 (12) : 1867-1868. DOI: 10.1097/TP.0b013e31817615e6.
 - [43] RAMZI M, IRAVANI S M, ZAREI T, *et al.* Association between cytotoxic T-lymphocyte antigen 4 gene polymorphisms and Torque Teno Virus infection after hematopoietic stem cell transplantation [J]. *Exp Clin Transplant*, 2021, 19 (3) : 259-263. DOI: 10.6002/ect.2017.0105.
 - [44] 张伊佳, 贾月萍, 张乐萍. CTLA-4 基因突变致原发性免疫缺陷病 1 例 [J]. *中国免疫学杂志*, 2019, 35 (2) : 220-222. DOI: 10.3969/j.issn.1000-484X.2019.02.018.
 - [45] ZANOTTA N, MAXIMOVA N, CAMPISCANO G, *et al.* Up-regulation of the monocyte chemotactic protein-3 in sera from bone marrow transplanted children with torquetenovirus infection [J]. *J Clin Virol*, 2015, 63: 6-11. DOI: 10.1016/j.jcv.2014.11.028.
 - [46] MANCUSO R, SARESELLA M, HERNIS A, *et al.* Torque teno virus (TTV) in multiple sclerosis patients with different patterns of disease [J]. *J Med Virol*, 2013, 85 (12) : 2176-2183. DOI: 10.1002/jmv.23707.
 - [47] ZHOU Y, FANG L, PENG L, *et al.* TLR9 and its signaling pathway in multiple sclerosis [J]. *J Neurol Sci*, 2017, 373: 95-99. DOI: 10.1016/j.jns.2016.12.027.
 - [48] GIACCONI R, MAGGI F, MACERA L, *et al.* Torquetenovirus (TTV) load is associated with mortality in Italian elderly subjects [J]. *Exp Gerontol*, 2018, 112: 103-111. DOI: 10.1016/j.exger.2018.09.003.
 - [49] 郑浩锋, 孙启全. 肾移植免疫学研究进展 [J]. *中国免疫学杂志*, 2018, 34 (7) : 961-966. DOI: 10.3969/j.issn.1000-484X.2018.07.001.

[收稿 2021-02-05 修回 2021-03-08]
(编辑 周文瑜)