·炎症与神经系统疾病·

基于“责任抗体”概念的自身免疫性脑炎诊断与治疗进展

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【摘要】 自身免疫性脑炎是神经系统免疫性疾病的重要组成之一，存在靶向神经元表面蛋白、离子通道或突触表面受体的自身抗体，自身抗体检测对疾病的诊断、治疗及预后评估具有重要意义。确定责任抗体是解决同一例患者多种自身抗体共存的重要方法，本文基于新近提出的“责任抗体”概念对自身免疫性脑炎诊断与治疗进展进行综述。

【关键词】 脑炎； 自身免疫疾病； 抗体； 综述

"Culprit antibody" concept based diagnosis and treatment strategy of autoimmune encephalitis

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【Abstract】 Autoimmune encephalitis (AE) with autoantibodies targeting neuronal surface proteins, ion channels or synaptic surface receptors is a major component of neuroimmune diseases. The detection of autoantibodies is of great value for the diagnosis, treatment and prognosis. Culprit antibody solve the problem of the coexistence of different autoantibodies in the same patient. This article review the relationship between culprit antibody and clinical phenotype in AE.

【Key words】 Encephalitis; Autoimmune diseases; Antibodies; Review

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神经系统免疫性疾病系免疫机制介导的、靶向神经系统自身抗原的自身免疫性疾病，中枢神经系统组织损伤和功能损害由相应抗体或特异性自身反应性T淋巴细胞介导。自身免疫性脑炎（AE）是神经系统免疫性疾病的重要组成之一，年发病率为0.8/10万[1]，临床症状严重，给家庭及社会带来沉重负担。自身抗体检测对疾病诊断、治疗及预后评估具有重要意义。临床实践中，同一例患者多种自身抗体共存现象给疾病的诊断与治疗造成困扰，责任抗体对理清自身抗体与临床表型之间的关系具有重要意义[2]。本文拟从我们研究团队新近提出的“责任抗体”概念出发，综述自身免疫性脑炎诊断与治疗进展。

一、自身免疫性脑炎发病机制与”责任抗体”概念的提出

责任抗体系指同一例患者病程中与一个或多个临床表型有对应因果关系的致病性抗体。自身免疫性脑炎相关自身抗体靶向神经元表面蛋白、离子通道或突触表面受体。在感染、肿瘤、免疫检查点抑制剂（CPI）等诱因下[3]，自身抗原暴露，打破机

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体免疫耐受，抗原提呈给B淋巴细胞，产生相应自身抗体。抗原抗体结合，使得受体数目、受体结构或相关信号转导通路改变，影响受体正常生理功能，引起突触电流、兴奋性和可塑性改变，在宏观层面出现相应临床表现，如癫痫发作、精神症状、近记忆障碍等[4-9]。例如，抗N-甲基-D-天冬氨酸受体（NMDAR）和α-氨基-3-羟基-5-甲基-4-异噁唑丙酸受体（AMPAR）抗体可直接导致受体内化[7]，抗γ-氨基丁酸A型受体（$GABA_AR$）抗体可选择性减少γ-氨基丁酸（GABA）能电流[10]，抗γ-氨基丁酸B型受体（$GABA_BR$）抗体可直接阻断受体功能[9,11]。NMDAR主要表达于海马和大脑皮质，参与学习和记忆等重要生理过程，在调节神经元存活、参与突触信号转导和可塑性形成等方面发挥重要作用；抗NMDAR抗体结合神经细胞胞膜NMDAR NR1亚单位胞外段，与NMDAR交联、内吞转运至内体和溶酶体，导致NMDAR数量可逆性减少，同时影响NMDAR胞外段与Ephrin-B2受体之间的相互作用，使胞膜表面多巴胺受体簇水平发生变化［多巴胺1型受体（D1R）水平下降，多巴胺2型受体（D2R）水平升高］[4-5,12-13]，由此可见，抗NMDAR抗体在抗NMDAR脑炎发病机制中发挥主导作用，是其责任抗体。

二、自身免疫性脑炎临床表型与责任抗体之间的关系

1.流行病学调查　自身免疫性脑炎好发于青壮年，但不同类型自身免疫性脑炎的性别和发病年龄各异，可以为责任抗体的确定提供线索。抗NMDAR脑炎以女性多见，中位发病年龄21岁，约37%患者发病年龄＜18岁[14-15]。此外，抗$GABA_AR$抗体相关脑炎、抗代谢型谷氨酸受体5（mGluR5）抗体相关脑炎、抗突触蛋白3α（neurexin-3α）抗体相关脑炎等亦通常于青壮年发病[16-18]。抗D2R抗体与基底节脑炎相关，好发于儿童[19]，而中老年人更易检出边缘性脑炎（LE）相关抗体，如抗富亮氨酸胶质瘤失活基因1（LGI1）、AMPAR、$GABA_BR$、接触蛋白相关蛋白-2（CASPR2）抗体[20-21]。国外文献报道，抗CASPR2抗体相关脑炎男女比例达9∶1[20]，我国男女比例约为2∶1[22]。抗LGI1抗体相关脑炎、抗$GABA_BR$抗体相关脑炎和抗mGluR5抗体相关脑炎亦多见于男性[18,21]，抗AMPAR抗体相关脑炎在女性中更常见[20]，抗D2R抗体相关基底节脑炎和抗$GABA_AR$抗体相关脑炎则无明显性别差异[10,19]。尽管目前尚无法明确各种自身抗体与性别、年龄在发病机制层面的关联性，但从临床表型角度看，性别和年龄仍可以给不同抗体阳性的自身免疫性脑炎的诊断提供重要线索。

2.病因、诱因及发病机制　感染是自身免疫性脑炎的潜在诱因，单纯疱疹病毒（HSV）是最常见的病原体[23-24]，约27%的单纯疱疹病毒性脑炎（HSE）可以进展为自身免疫性脑炎[25]，以抗NMDAR脑炎为主，亦有36%的患者检出其他自身抗体[25]，如抗电压门控性钙离子通道（VGCC）抗体[26]。其他病毒与抗NMDAR脑炎的关联性偶有报道，如流行性乙型脑炎病毒、水痘-带状疱疹病毒（VZV）甚至人类免疫缺陷病毒（HIV）[24,27]。链球菌感染是抗D2R抗体相关基底节脑炎的重要诱因之一[19]，链球菌感染诱导血-脑屏障破坏的小鼠模型亦支持这一观点[28]。感染诱发自身免疫性脑炎的可能机制是病原体侵袭致脑组织炎症和坏死，血-脑屏障破坏，中枢神经系统免疫耐受被打破，从而产生自身抗体[29]。此外，Toll样受体（TLR）功能障碍、抗原表位扩散和隐蔽抗原暴露与自身免疫性脑炎的相关性有待进一步研究[24,30]。与感染不同，恶性肿瘤中神经细胞内抗原的异位表达致自身免疫反应与中枢神经系统同源蛋白交叉反应是可能的致病机制[3,31]。畸胎瘤是抗NMDAR脑炎较明确的病因，近50%的女性抗NMDAR脑炎患者伴发畸胎瘤。畸胎瘤包含致密的B淋巴细胞和T淋巴细胞浸润以及表达NMDAR的神经元发育异常，是对这一假设的有力支持[32-33]。其他与抗NMDAR脑炎相关的肿瘤有肺癌、乳腺癌等，但较少见[34]。约60%的抗$GABA_BR$抗体相关脑炎患者伴发潜在的小细胞肺癌，60%的抗AMPAR抗体相关脑炎患者伴发非小细胞肺癌、乳腺癌或胸腺瘤[20,35]。一项纳入264例小细胞肺癌患者的前瞻性队列研究显示，9.41%（24/255）患者确诊为副肿瘤性神经系统疾病，抗体检测主要为抗VGCC抗体，其次为抗$GABA_BR$抗体约占12.5%，而抗CASPR2、LGI1和NMDAR抗体罕见（＜5%）[36]。胸腺瘤的抗体检测显示，抗$GABA_AR$抗体最常见，其次为抗AMPAR抗体，其余边缘性脑炎相关抗体也有文献报道[37]。总之，抗LGI1抗体相关脑炎较少合并肿瘤，抗mGluR5和mGluR1抗体与霍奇金淋巴瘤存在较高的相关性[18,38]。免疫检查点抑制剂广泛应用于肿瘤的临床治疗，亦有免疫检查点抑制剂相关脑炎的报道[39-42]。免疫检查点抑制剂促进T淋巴细胞活化，刺激自身抗体产生，诱导神经系统免疫炎症反

应[43]，特定基因型似乎也在其中发挥作用[44]，例如，*HLA - B*27: 05* 可能与免疫检查点抑制剂Atezolizumab相关脑炎相关，抗LGI1抗体相关脑炎患者*HLA-DRB1*07:01*呈阳性，抗CASPR2抗体相关脑炎患者过表达*HLA-DRB1*11:01*，抗IgLON5抗体相关脑病与*HLA-DRB1*10:01*和*HLA-DQB1*05:01*相关，抗NMDAR脑炎在欧洲人群中与*HLA-B*07:02*呈弱相关、在中国人群中则与*HLA-DRB1*16:02*呈弱相关。研究显示，抗Ma2、Hu、Yo等神经细胞内抗原抗体较抗神经细胞表面抗原抗体更常见，后者约10%为抗NMDAR和CASPR2抗体[45]。无局灶性神经功能缺损症状、抗体阴性、脑脊液检查提示明显炎症改变、同时出现抗谷氨酸脱羧酶（GAD）抗体和抗神经细胞表面抗原抗体的免疫检查点抑制剂相关脑炎患者通常预后良好，而表现为局灶性神经功能缺损症状、MRI显示异常病灶、同时出现抗神经细胞内抗原抗体的免疫检查点抑制剂相关脑炎患者则预后不良[46]。

3.临床症状　自身免疫性脑炎急性期，癫痫发作频繁，基于不同的责任抗体，其发作频率为33%～100%，但大多数患者癫痫发作并不持续且随着脑炎的恢复得以控制[18,47-50]。较常见的责任抗体包括抗$GABA_AR$、$GABA_BR$、LGI1和NMDAR抗体[51-52]。由于临床症状的重叠，基于临床表型预测责任抗体十分困难，但除外抗LGI1抗体，面-臂肌张力障碍发作（FBDS）是抗LGI1抗体相关脑炎的特异性临床表现，见于高达70%患者[53]。大多数抗$GABA_AR$抗体相关脑炎患者出现难治性癫痫和癫痫持续状态[54]。儿童最常见的是抗NMDAR脑炎，且通常以癫痫发作发病；约75%的成年抗NMDAR脑炎出现癫痫发作[55]。多种抗神经细胞表面抗原抗体与进行性痴呆相关，如抗NMDAR、LGI1、AMPAR、$GABA_BR$、CASPR2、mGluR5、IgLON5和甘氨酸受体（GlyR）抗体等[18,56-59]。出现非典型早期痴呆症状的患者，主要存在抗NMDAR抗体[60-61]；精神症状包括定向力障碍、情绪障碍、紧张症等，与多种责任抗体相关，其中，抗电压门控性钾离子通道（VGKC）和mGluR5抗体阳性患者出现自杀行为[62-63]；紧张症有其特异性，仅见于抗NMDAR脑炎患者[14]。自身免疫性脑炎患者存在所有类型的睡眠障碍，包括失眠、异态睡眠、过度睡眠和睡眠呼吸障碍，此类患者最常检出抗IgLON5和NMDAR抗体[64]。有90%的抗NDMAR脑炎患者伴发失眠[65]，自身免疫性脑炎相关失眠（抗NMDAR、CASPR2和LGI1抗体相关睡眠障碍）发病急骤，症状较严重，且与幻觉或行为异常相关[65-66]。觉醒或睡眠期出现肢体不自主运动或周期性运动，是抗IgLON5抗体相关脑病的典型临床表现[67]，亦可见于抗DPPX抗体相关脑炎[68]。抗IgLON5抗体相关脑病因喉阻塞伴喘鸣导致阻塞性睡眠呼吸暂停[67]，抗NMDAR脑炎患者出现睡眠觉醒节律紊乱[65,69]，快速眼动睡眠期行为障碍（RBD）则见于抗LGI1抗体相关脑炎、抗CASPR2抗体相关脑炎和抗IgLON5抗体相关脑病[67,70]。自身免疫性脑炎患者普遍存在运动障碍，主要见于≤12岁的抗NMDAR脑炎患儿，口面部不自主运动是其特征性临床表现，其他症状还包括舞蹈病、刻板动作、紧张症、肌张力障碍等[71-73]。帕金森病样症状是抗D2R抗体相关基底节脑炎的特征性表现[19]。神经性肌强直是抗CASPR2抗体相关脑炎累及周围神经系统的表现，较少见于抗LGI1抗体相关脑炎和抗接触蛋白-2抗体相关脑炎[74-75]。由于抗GAD抗体属于抗神经细胞内抗原抗体，不具有致病性，故僵人综合征（SPS）和抗GlyR抗体阳性伴强直和肌阵挛的进展性脑脊髓炎（PERM）的责任抗体很可能是抗GlyR和Amphiphysin抗体，抗DPPX抗体的概率较小[76-78]。自主神经功能障碍常提示抗NMDAR脑炎，亦见于抗CASPR2抗体相关脑炎、抗LGI1抗体相关脑炎、僵人综合征，临床主要表现为高热、心动过速、唾液分泌过多、高血压或低血压、心动过缓、小便不连续、勃起功能障碍等，甚至有可能出现中枢性低通气[14,70,79-80]。抗DPPX抗体相关脑炎常伴发腹泻或其他胃肠道症状[81]。

4.影像学表现　MRI是临床诊断自身免疫性脑炎的重要方法，不同模态MRI图像可以为责任抗体的确认提供线索。边缘性脑炎通常表现为颞叶内侧T_2-FLAIR成像高信号[15]，抗$GABA_AR$抗体相关脑炎表现为皮质及皮质下广泛性T_2-FLAIR成像高信号[16]，基底节区T_2-FLAIR成像高信号则提示抗D2R抗体相关基底节脑炎[19]。^{18}F-脱氧葡萄糖（^{18}F-FDG）PET作为自身免疫性脑炎的辅助诊断手段，较MRI更敏感，主要表现为可逆性代谢降低[82]。边缘性脑炎早期可见颞叶内侧葡萄糖代谢增高[83-84]，而初级运动皮质未见异常[83,85-86]。约50%的抗NMDAR脑炎患者MRI无明显异常[87]，^{18}F-FDG PET表现为特征性额颞叶高代谢和枕叶低代谢[88-89]。不同病因抗NMDAR脑炎的^{18}F-FDG PET代谢模式不同，隐源性

自身免疫性脑炎和肿瘤相关自身免疫性脑炎可见额颞叶和基底节区高代谢伴枕叶低代谢，其中，隐源性自身免疫性脑炎的异常代谢通常不对称；病毒性脑炎后抗NMDAR抗体相关脑炎表现为双侧枕叶、单侧颞叶和部分基底节区明显低代谢，对侧颞叶高代谢[90]。

三、责任抗体指导临床实践中的诊断与治疗

大多数自身免疫性脑炎经一线或二线治疗后效果较好。抗IgLON5抗体相关脑病患者预后较差，部分患者有猝死的风险，可能与睡眠呼吸障碍有关，并且对持续气道正压通气（CPAP）治疗的反应较好[67,91-92]。抗IgLON5、CASPR2、LGI1、DPPX抗体以IgG4亚型为主，抗$GABA_BR$、NMDAR、AMPAR抗体以IgG1亚型为主且与肿瘤的相关性更显著，提示肿瘤筛查的必要性[93-95]。抗LGI1抗体相关脑炎较高的脑脊液特异性LGI1-IgG4滴度和指数与较差的预后相关，且预后不良患者更易接受静脉注射免疫球蛋白（IVIg），进一步分层分析显示，预后不良患者LGI1-IgG4指数高于预后良好患者（$P=0.040$）[96]。晚近研究显示，除表现为僵人综合征的抗GAD65抗体相关脑炎对糖皮质激素或静脉注射免疫球蛋白有较高的有效率（分别为60%和77.78%）外，表现为其他症状的患者对这两种免疫治疗效果欠佳[97]。抗NMDAR脑炎患者的极端δ刷模式与病程延长有关[98]，应尽早予以免疫治疗。此外，及时有效的对症支持治疗也是重要一环。约70%的抗NMDAR脑炎患者因持续性自主神经功能障碍、意识障碍和中枢性低通气，需呼吸机辅助通气和重症监护，部分患者还需安装临时心脏起搏器，甚至有可能因心脏停搏而死亡[99-101]。有60%～88%的抗LGI1抗体相关脑炎患者存在顽固性低钠血症，因此补钠和监测电解质是必要的[75,102-103]。抗$GABA_AR$和$GABA_BR$抗体相关脑炎伴发的难治性癫痫对抗癫痫药物治疗反应较差，且易进展为癫痫持续状态，可选择广谱抗癫痫药物、地西泮或咪达唑仑以终止癫痫持续状态，并予以生命支持治疗[16,48,104]。

综上所述，在精准医疗时代，从核心临床表型出发，探究责任抗体与疾病之间的关系，为临床精准诊断与治疗提供帮助，是未来发展方向。靶抗原功能、自身抗体致病机制的深入研究是桥连临床表型与责任抗体的关键途径。临床表型的精准刻画有助于实现以临床表型为指导的早期自身抗体相关疾病的识别、精准抗体送检，因此具有重要的临床实践意义。

利益冲突 无

参 考 文 献

[1] Dubey D, Pittock SJ, Kelly CR, McKeon A, Lopez-Chiriboga AS, Lennon VA, Gadoth A, Smith CY, Bryant SC, Klein CJ, Aksamit AJ, Toledano M, Boeve BF, Tillema JM, Flanagan EP. Autoimmune encephalitis epidemiology and a comparison to infectious encephalitis[J]. Ann Neurol, 2018, 83:166-177.

[2] Chen XJ, Li HF, Qiu W, Xu Y, Chen S. Neuroimmune diseases and responsible antibodies[J]. Zhongguo Shen Jing Mian Yi Xue He Shen Jing Bing Xue Za Zhi, 2021, 28:283-287.[陈向军, 李海峰, 邱伟, 徐雁, 陈晟. 神经免疫疾病与责任抗体[J]. 中国神经免疫学和神经病学杂志, 2021, 28:283-287.]

[3] Vogrig A, Muñiz-Castrillo S, Desestret V, Joubert B, Honnorat J. Pathophysiology of paraneoplastic and autoimmune encephalitis: genes, infections, and checkpoint inhibitors[J]. Ther Adv Neurol Disord, 2020, 13:1756286420932797.

[4] Wollmuth LP, Chan K, Groc L. The diverse and complex modes of action of anti-NMDA receptor autoantibodies[J]. Neuropharmacology, 2021, 194:108624.

[5] Ding Y, Zhou Z, Chen J, Peng Y, Wang H, Qiu W, Xie W, Zhang J, Wang H. Anti-NMDAR encephalitis induced in mice by active immunization with a peptide from the amino-terminal domain of the GluN1 subunit[J]. J Neuroinflammation, 2021, 18:53.

[6] Zekeridou A, Pittock SJ. Synaptic autoimmunity: new insights into LGI1 antibody-mediated neuronal dysfunction[J]. Brain, 2020, 143:1622-1625.

[7] Gardoni F, Stanic J, Scheggia D, Benussi A, Borroni B, Di Luca M. NMDA and AMPA receptor autoantibodies in brain disorders: from molecular mechanisms to clinical features[J]. Cells, 2021, 10:77.

[8] Brändle SM, Cerina M, Weber S, Held K, Menke AF, Alcalá C, Gebert D, Herrmann AM, Pellkofer H, Gerdes LA, Bittner S, Leypoldt F, Teegen B, Komorowski L, Kümpfel T, Hohlfeld R, Meuth SG, Casanova B, Melzer N, Beltrán E, Dornmair K. Cross-reactivity of a pathogenic autoantibody to a tumor antigen in GABAA receptor encephalitis[J]. Proc Natl Acad Sci USA, 2021, 118:e1916337118.

[9] Nibber A, Mann EO, Pettingill P, Waters P, Irani SR, Kullmann DM, Vincent A, Lang B. Pathogenic potential of antibodies to the GABAB receptor[J]. Epilepsia Open, 2017, 2:355-359.

[10] Kreye J, Wright SK, van Casteren A, Stöffler L, Machule ML, Reincke SM, Nikolaus M, van Hoof S, Sanchez-Sendin E, Homeyer MA, Cordero Gómez C, Kornau HC, Schmitz D, Kaindl AM, Boehm-Sturm P, Mueller S, Wilson MA, Upadhya MA, Dhangar DR, Greenhill S, Woodhall G, Turko P, Vida I, Garner CC, Wickel J, Geis C, Fukata Y, Fukata M, Prüss H. Encephalitis patient-derived monoclonal GABAA receptor antibodies cause epileptic seizures[J]. J Exp Med, 2021, 218:e20210012.

[11] Jain A, Lancaster E, Dalmau J, Balice-Gordon RJ. Autoantibodies in the CSF of anti-GABAB receptor encephalitis patients block activation of GABAB receptors in vitro[J]. Ann Neurol, 2015, 78:S77.

[12] Mikasova L, De Rossi P, Bouchet D, Georges F, Rogemond V, Didelot A, Meissirel C, Honnorat J, Groc L. Disrupted surface cross-talk between NMDA and Ephrin-B2 receptors in anti-NMDA encephalitis[J]. Brain, 2012, 135(Pt 5):1606-1621.

[13] Carceles-Cordon M, Mannara F, Aguilar E, Castellanos A, Planagumà J, Dalmau J. NMDAR antibodies alter dopamine receptors and cause psychotic behavior in mice[J]. Ann Neurol, 2020, 88:603-613.
[14] Dalmau J, Armangué T, Planagumà J, Radosevic M, Mannara F, Leypoldt F, Geis C, Lancaster E, Titulaer MJ, Rosenfeld MR, Graus F. An update on anti-NMDA receptor encephalitis for neurologists and psychiatrists: mechanisms and models[J]. Lancet Neurol, 2019, 18:1045-1057.
[15] Shan W, Yang H, Wang Q. Neuronal surface antibody-medicated autoimmune encephalitis (limbic encephalitis) in China: a multiple-center, retrospective study[J]. Front Immunol, 2021, 12:621599.
[16] O'Connor K, Waters P, Komorowski L, Zekeridou A, Guo CY, Mgbachi VC, Probst C, Mindorf S, Teegen B, Gelfand JM, Geschwind MD, Lennon V, Pittock SJ, McKeon A. GABAA receptor autoimmunity: a multicenter experience[J]. Neurol Neuroimmunol Neuroinflamm, 2019, 6:e552.
[17] Gresa-Arribas N, Planagumà J, Petit-Pedrol M, Kawachi I, Katada S, Glaser CA, Simabukuro MM, Armangué T, Martínez-Hernández E, Graus F, Dalmau J. Human neurexin-3α antibodies associate with encephalitis and alter synapse development[J]. Neurology, 2016, 86:2235-2242.
[18] Spatola M, Sabater L, Planagumà J, Martínez-Hernandez E, Armangué T, Prüss H, Iizuka T, Caparó Oblitas RL, Antoine JC, Li R, Heaney N, Tubridy N, Munteis Olivas E, Rosenfeld MR, Graus F, Dalmau J. Encephalitis with mGluR5 antibodies: symptoms and antibody effects[J]. Neurology, 2018, 90:e1964-1972.
[19] Dale RC, Merheb V, Pillai S, Wang D, Cantrill L, Murphy TK, Ben-Pazi H, Varadkar S, Aumann TD, Horne MK, Church AJ, Fath T, Brilot F. Antibodies to surface dopamine-2 receptor in autoimmune movement and psychiatric disorders[J]. Brain, 2012, 135(Pt 11):3453-3468.
[20] Zhang TY, Cai MT, Zheng Y, Lai QL, Shen CH, Qiao S, Zhang YX. Anti-alpha-amino-3-hydroxy-5-methyl-4-isoxazolepropionic acid receptor encephalitis: a review[J]. Front Immunol, 2021, 12:652820.
[21] Ghimire P, Khanal UP, Gajurel BP, Karn R, Rajbhandari R, Paudel S, Gautam N, Ojha R. Anti-LGI1, anti-GABABR, and anti-CASPR2 encephalitides in Asia: a systematic review[J]. Brain Behav, 2020, 10:e01793.
[22] Qin X, Yang H, Zhu F, Wang Q, Shan W. Clinical character of CASPR2 autoimmune encephalitis: a multiple center retrospective study[J]. Front Immunol, 2021, 12:652864.
[23] Alexopoulos H, Akrivou S, Mastroyanni S, Antonopoulou M, Dinopoulos A, Giorgi M, Konstantinou K, Kouremenos E, Lariou M, Naoumis D, Pavlidou E, Pavlou E, Voudris K, Vlachoyiannopoulos P, Dalakas MC. Postherpes simplex encephalitis: a case series of viral-triggered autoimmunity, synaptic autoantibodies and response to therapy[J]. Ther Adv Neurol Disord, 2018, 11:1756286418768778.
[24] Joubert B, Dalmau J. The role of infections in autoimmune encephalitides[J]. Rev Neurol (Paris), 2019, 175:420-426.
[25] Armangue T, Spatola M, Vlagea A, Mattozzi S, Cárceles-Cordon M, Martinez-Heras E, Llufriu S, Muchart J, Erro ME, Abraira L, Moris G, Monros-Giménez L, Corral-Corral Í, Montejo C, Toledo M, Bataller L, Secondi G, Ariño H, Martínez-Hernández E, Juan M, Marcos MA, Alsina L, Saiz A, Rosenfeld MR, Graus F, Dalmau J; Spanish Herpes Simplex Encephalitis Study Group. Frequency, symptoms, risk factors, and outcomes of autoimmune encephalitis after herpes simplex encephalitis: a prospective observational study and retrospective analysis[J]. Lancet Neurol, 2018, 17:760-772.
[26] Bradshaw MJ, Pawate S, Lennon VA, Bloch KC, Brown KM. Herpes simplex virus 1 encephalitis associated with voltage-gated calcium channel autoimmunity[J]. Neurology, 2015, 85:2176-2177.
[27] Moloney PB, Hutchinson S, Heskin J, Mulcahy F, Langan Y, Conlon NP, Linas BP, Takahashi C, Cervantes-Arslanian AM. Possible N-methyl-D-aspartate receptor antibody-mediated encephalitis in the setting of HIV cerebrospinal fluid escape[J]. J Neurol, 2020, 267:1348-1352.
[28] Platt MP, Bolding KA, Wayne CR, Chaudhry S, Cutforth T, Franks KM, Agalliu D. Th17 lymphocytes drive vascular and neuronal deficits in a mouse model of postinfectious autoimmune encephalitis[J]. Proc Natl Acad Sci USA, 2020, 117:6708-6716.
[29] Dalmau J, Graus F. Antibody-mediated encephalitis[J]. N Engl J Med, 2018, 378:840-851.
[30] Piquet AL, Clardy SL. Infection, immunodeficiency, and inflammatory diseases in autoimmune neurology[J]. Semin Neurol, 2018, 38:379-391.
[31] Prüss H. Autoantibodies in neurological disease[J]. Nat Rev Immunol, 2021, 21:798-813.
[32] Makuch M, Wilson R, Al-Diwani A, Varley J, Kienzler AK, Taylor J, Berretta A, Fowler D, Lennox B, Leite MI, Waters P, Irani SR. N-methyl-D-aspartate receptor antibody production from germinal center reactions: therapeutic implications[J]. Ann Neurol, 2018, 83:553-561.
[33] Jiang XY, Lei S, Zhang L, Liu X, Lin MT, Blumcke I, Piao YS, Zhou D, Li JM. Co-expression of NMDA-receptor subunits NR1, NR2A, and NR2B in dysplastic neurons of teratomas in patients with paraneoplastic NMDA-receptor-encephalitis: a retrospective clinico-pathology study of 159 patients[J]. Acta Neuropathol Commun, 2020, 8:130.
[34] Chefdeville A, Treilleux I, Mayeur ME, Couillault C, Picard G, Bost C, Mokhtari K, Vasiljevic A, Meyronet D, Rogemond V, Psimaras D, Dubois B, Honnorat J, Desestret V. Immunopathological characterization of ovarian teratomas associated with anti-N-methyl-D-aspartate receptor encephalitis[J]. Acta Neuropathol Commun, 2019, 7:38.
[35] van Coevorden-Hameete MH, de Bruijn MAAM, de Graaff E, Bastiaansen DAEM, Schreurs MWJ, Demmers JAA, Ramberger M, Hulsenboom ESP, Nagtzaam MMP, Boukhrissi S, Veldink JH, Verschuuren JJGM, Hoogenraad CC, Sillevis Smitt PAE, Titulaer MJ. The expanded clinical spectrum of anti-GABABR encephalitis and added value of KCTD16 autoantibodies[J]. Brain, 2019, 142:1631-1643.
[36] Gozzard P, Woodhall M, Chapman C, Nibber A, Waters P, Vincent A, Lang B, Maddison P. Paraneoplastic neurologic disorders in small cell lung carcinoma: a prospective study[J]. Neurology, 2015, 85:235-239.
[37] Guasp M, Landa J, Martinez-Hernandez E, Sabater L, Iizuka T, Simabukuro M, Nakamura M, Kinoshita M, Kurihara M, Kaida K, Bruna J, Kapetanovic S, Sánchez P, Ruiz-García R, Naranjo L, Planagumà J, Muñoz-Lopetegi A, Bataller L, Saiz A, Dalmau J, Graus F. Thymoma and autoimmune encephalitis: clinical manifestations and antibodies[J]. Neurol Neuroimmunol Neuroinflamm, 2021, 8:e1053.
[38] Spatola M, Petit Pedrol M, Maudes E, Simabukuro M, Muñiz-Castrillo S, Pinto AL, Wandinger KP, Spiegler J, Schramm P, Dutra LA, Iorio R, Kornblum C, Bien CG, Höftberger R, Leypoldt F, Titulaer MJ, Sillevis Smitt P, Honnorat J, Rosenfeld MR, Graus F, Dalmau J. Clinical features, prognostic factors, and antibody effects in anti-mGluR1

encephalitis[J]. Neurology, 2020, 95:e3012-3025.
[39] Kapadia RK, Ney DE, Hannan M, Farley M, Pastula DM, Piquet AL. Glial fibrillary acidic protein (GFAP) associated autoimmune meningoencephalitis in a patient receiving nivolumab[J]. J Neuroimmunol, 2020, 344:577259.
[40] Segal Y, Bukstein F, Raz M, Aizenstein O, Alcalay Y, Gadoth A. PD-1-inhibitor-induced PCA-2 (MAP1B) autoimmunity in a patient with renal cell carcinoma[J]. Cerebellum, 2021.[Epub ahead of print]
[41] Chevalier K, Noel N, Benoudiba F, Chrétien P, Hacein-Bey-Abina S, Lambotte O. Anti-Ma2 antibody encephalitis associated with Sjogren's syndrome[J]. Rev Med Interne, 2021, 42:575-578.
[42] Piepgras J, Müller A, Steffen F, Lotz J, Loquai C, Zipp F, Dresel C, Bittner S. Neurofilament light chain levels reflect outcome in a patient with glutamic acid decarboxylase 65 antibody-positive autoimmune encephalitis under immune checkpoint inhibitor therapy[J]. Eur J Neurol, 2021, 28:1086-1089.
[43] Vogrig A, Muñiz-Castrillo S, Joubert B, Picard G, Rogemond V, Marchal C, Chiappa AM, Chanson E, Skowron F, Leblanc A, Ducray F, Honnorat J. Central nervous system complications associated with immune checkpoint inhibitors[J]. J Neurol Neurosurg Psychiatry, 2020, 91:772-778.
[44] Chang H, Shin YW, Keam B, Kim M, Im SA, Lee ST. HLA-B27 association of autoimmune encephalitis induced by PD-L1 inhibitor[J]. Ann Clin Transl Neurol, 2020, 7:2243-2250.
[45] Nersesjan V, McWilliam O, Krarup LH, Kondziella D. Autoimmune encephalitis related to cancer treatment with immune checkpoint inhibitors: a systematic review[J]. Neurology, 2021, 97:e191-202.
[46] Velasco R, Villagrán M, Jové M, Simó M, Vilariño N, Alemany M, Palmero R, Martínez-Villacampa MM, Nadal E, Bruna J. Encephalitis induced by immune checkpoint inhibitors: a systematic review[J]. JAMA Neurol, 2021, 78:864-873.
[47] Shen CH, Fang GL, Yang F, Cai MT, Zheng Y, Fang W, Guo Y, Zhang YX, Ding MP. Seizures and risk of epilepsy in anti-NMDAR, anti-LGI1, and anti-GABABR encephalitis[J]. Ann Clin Transl Neurol, 2020, 7:1392-1399.
[48] Suga H, Yanagida A, Kanazawa N, Ohara H, Kitagawa T, Hayashi M, Onozawa Y, Nagata N, Kaneko J, Kitamura E, Nishiyama K, Iizuka T. Status epilepticus suspected autoimmune: neuronal surface antibodies and main clinical features[J]. Epilepsia, 2021, 62:2719-2731.
[49] Bozzetti S, Rossini F, Ferrari S, Delogu R, Cantalupo G, Marchioretto F, Zanette G, Zanoni T, Turatti M, Vitale G, Cadaldini M, Rossi F, Di Tizio L, Zuco C, Maniscalco GT, Soldani F, Monaco S, Trinka E, Hoeftberger R, Mariotto S. Epileptic seizures of suspected autoimmune origin: a multicentre retrospective study[J]. J Neurol Neurosurg Psychiatry, 2020, 91:1145-1153.
[50] Yeshokumar AK, Coughlin A, Fastman J, Psaila K, Harmon M, Randell T, Schorr EM, Han H, Hoang H, Soudant C, Jette N. Seizures in autoimmune encephalitis: a systematic review and quantitative synthesis[J]. Epilepsia, 2021, 62:397-407.
[51] Stanciu GD, Bild V, Ababei DC, Rusu RN, Beschea Chiriac SI, Rezuş E, Luca A. Relevance of surface neuronal protein autoantibodies as biomarkers in seizure-associated disorders[J]. Int J Mol Sci, 2019, 20:4529.
[52] Geis C, Planagumà J, Carreño M, Graus F, Dalmau J. Autoimmune seizures and epilepsy[J]. J Clin Invest, 2019, 129:926-940.
[53] Irani SR, Michell AW, Lang B, Pettingill P, Waters P, Johnson MR, Schott JM, Armstrong RJ, S Zagami A, Bleasel A, Somerville ER, Smith SM, Vincent A. Faciobrachial dystonic seizures precede LGI1 antibody limbic encephalitis[J]. Ann Neurol, 2011, 69:892-900.
[54] Spatola M, Petit-Pedrol M, Simabukuro MM, Armangue T, Castro FJ, Barcelo Artigues MI, Julià Benique MR, Benson L, Gorman M, Felipe A, Caparó Oblitas RL, Rosenfeld MR, Graus F, Dalmau J. Investigations in GABAA receptor antibody-associated encephalitis[J]. Neurology, 2017, 88:1012-1020.
[55] Nissen MS, Ørvik MS, Nilsson AC, Ryding M, Lydolph M, Blaabjerg M. NMDA-receptor encephalitis in Denmark from 2009 to 2019: a national cohort study[J]. J Neurol, 2021.[Epub ahead of print]
[56] Banks SA, Sechi E, Flanagan EP. Autoimmune encephalopathies presenting as dementia of subacute onset and rapid progression[J]. Ther Adv Neurol Disord, 2021, 14:1756286421998906.
[57] Zeng W, Cao L, Zheng J, Yu L. Clinical characteristics and long-term prognosis of relapsing anti-N-methyl-D-aspartate receptor encephalitis: a retrospective, multicenter, self-controlled study[J]. Neurol Sci, 2021, 42:199-207.
[58] Hansen N, Malchow B, Zerr I, Stöcker W, Wiltfang J, Timäus C. Neural cell-surface and intracellular autoantibodies in patients with cognitive impairment from a memory clinic cohort[J]. J Neural Transm (Vienna), 2021, 128:357-369.
[59] Brunetti V, Della Marca G, Spagni G, Iorio R. Immunotherapy improves sleep and cognitive impairment in anti-IgLON5 encephalopathy[J]. Neurol Neuroimmunol Neuroinflamm, 2019, 6:e577.
[60] Doss S, Wandinger KP, Hyman BT, Panzer JA, Synofzik M, Dickerson B, Mollenhauer B, Scherzer CR, Ivinson AJ, Finke C, Schöls L, Müller Vom Hagen J, Trenkwalder C, Jahn H, Höltje M, Biswal BB, Harms L, Ruprecht K, Buchert R, Höglinger GU, Oertel WH, Unger MM, Körtvélyessy P, Bittner D, Priller J, Spruth EJ, Paul F, Meisel A, Lynch DR, Dirnagl U, Endres M, Teegen B, Probst C, Komorowski L, Stöcker W, Dalmau J, Prüss H. High prevalence of NMDA receptor IgA/IgM antibodies in different dementia types[J]. Ann Clin Transl Neurol, 2014, 1:822-832.
[61] Gibson LL, McKeever A, Cullen AE, Nicholson TR, Aarsland D, Zandi MS, Pollak TA. Neuronal surface autoantibodies in dementia: a systematic review and meta-analysis[J]. J Neurol, 2021, 268:2769-2779.
[62] Kruse JL, Lapid MI, Lennon VA, Klein CJ, Toole OO, Pittock SJ, Strand EA, Frye MA, McKeon A. Psychiatric autoimmunity: N-methyl-D-aspartate receptor IgG and beyond[J]. Psychosomatics, 2015, 56:227-241.
[63] Soto-Rincón CA, Castillo-Torres SA, Cantú-García DA, Estrada-Bellmann I, Chávez-Luévanos B, Marfil A. The poor insane Ophelia: reconsidering Ophelia syndrome[J]. Arq Neuropsiquiatr, 2019, 77:828-831.
[64] Muñoz-Lopetegi A, Graus F, Dalmau J, Santamaria J. Sleep disorders in autoimmune encephalitis[J]. Lancet Neurol, 2020, 19:1010-1022.
[65] Ariño H, Muñoz-Lopetegi A, Martinez-Hernandez E, Armangue T, Rosa-Justicia M, Escudero D, Matos N, Graus F, Sugranyes G, Castro-Fornieles J, Compte A, Dalmau J, Santamaria J. Sleep disorders in anti-NMDAR encephalitis[J]. Neurology, 2020, 95:e671-684.
[66] Devine MF, Feemster JC, Lieske EA, McCarter SJ, Sandness DJ, Steele T, Timm PC, Mandrekar J, Boeve BF, Silber MH, Dubey D, McKeon A, St Louis EK. Objective sleep profile in LGI1/CASPR2 autoimmunity[J]. Sleep, 2021.[Epub ahead of

print]
[67] Gaig C, Iranzo A, Cajochen C, Vilaseca I, Embid C, Dalmau J, Graus F, Santamaria J. Characterization of the sleep disorder of anti-IgLON5 disease[J]. Sleep, 2019, 42:zsz133.
[68] Tobin WO, Lennon VA, Komorowski L, Probst C, Clardy SL, Aksamit AJ, Appendino JP, Lucchinetti CF, Matsumoto JY, Pittock SJ, Sandroni P, Tippmann-Peikert M, Wirrell EC, McKeon A. DPPX potassium channel antibody: frequency, clinical accompaniments, and outcomes in 20 patients[J]. Neurology, 2014, 83:1797-1803.
[69] Al-Diwani A, Handel A, Townsend L, Pollak T, Leite MI, Harrison PJ, Lennox BR, Okai D, Manohar SG, Irani SR. The psychopathology of NMDAR-antibody encephalitis in adults: a systematic review and phenotypic analysis of individual patient data[J]. Lancet Psychiatry, 2019, 6:235-246.
[70] Lin N, Hao H, Guan H, Sun H, Liu Q, Lu Q, Jin L, Ren H, Huang Y. Sleep disorders in leucine-rich glioma-inactivated protein 1 and contactin protein-like 2 antibody-associated diseases[J]. Front Neurol, 2020, 11:696.
[71] Pruetarat N, Netbaramee W, Pattharathitikul S, Veeravigrom M. Clinical manifestations, treatment outcomes, and prognostic factors of pediatric anti-NMDAR encephalitis in tertiary care hospitals: a multicenter retrospective/prospective cohort study[J]. Brain Dev, 2019, 41:436-442.
[72] Giri YR, Parrill A, Damodar S, Fogel J, Ayed N, Syed M, Korie I, Ayyanar S, Typhair C, Hashmi S. Anti-N-methyl-D-aspartate receptor (NMDAR) encephalitis in children and adolescents: a systematic review and quantitative analysis of reported cases[J]. J Can Acad Child Adolesc Psychiatry, 2021, 30:236-248.
[73] Baizabal-Carvallo JF, Stocco A, Muscal E, Jankovic J. The spectrum of movement disorders in children with anti-NMDA receptor encephalitis[J]. Mov Disord, 2013, 28:543-547.
[74] van Sonderen A, Petit-Pedrol M, Dalmau J, Titulaer MJ. The value of LGI1, Caspr2 and voltage-gated potassium channel antibodies in encephalitis[J]. Nat Rev Neurol, 2017, 13:290-301.
[75] Gadoth A, Pittock SJ, Dubey D, McKeon A, Britton JW, Schmeling JE, Smith A, Kotsenas AL, Watson RE, Lachance DH, Flanagan EP, Lennon VA, Klein CJ. Expanded phenotypes and outcomes among 256 LGI1/CASPR2-IgG-positive patients[J]. Ann Neurol, 2017, 82:79-92.
[76] Balint B, Jarius S, Nagel S, Haberkorn U, Probst C, Blöcker IM, Bahtz R, Komorowski L, Stöcker W, Kastrup A, Kuthe M, Meinck HM. Progressive encephalomyelitis with rigidity and myoclonus: a new variant with DPPX antibodies[J]. Neurology, 2014, 82:1521-1528.
[77] Carvajal-González A, Leite MI, Waters P, Woodhall M, Coutinho E, Balint B, Lang B, Pettingill P, Carr A, Sheerin UM, Press R, Press R, Lunn MP, Lim M, Maddison P, Meinck HM, Vandenberghe W, Vincent A. Glycine receptor antibodies in PERM and related syndromes: characteristics, clinical features and outcomes[J]. Brain, 2014, 137(Pt 8):2178-2192.
[78] Graus F, Saiz A, Dalmau J. GAD antibodies in neurological disorders: insights and challenges[J]. Nat Rev Neurol, 2020, 16:353-365.
[79] Mizutani Y, Adachi S, Nakano S, Hayashi K, Higashi A, Kikuchi K, Maeda T, Murate K, Shima S, Iizuka T, Ueda A, Ito M, Watanabe H. Severe dysautonomia in glycine receptor antibody-positive progressive encephalomyelitis with rigidity and myoclonus (PERM): a case report[J]. Auton Neurosci, 2022, 237:102910.
[80] Martinez-Hernandez E, Ariño H, Mckeon A, Iizuka T, Titulaer MJ, Simabukuro MM, Lancaster E, Petit-Pedrol M, Planagumà J, Blanco Y, Harvey RJ, Saiz A, Graus F, Dalmau J. Clinical and immunologic investigations in patients with stiff-person spectrum disorder[J]. JAMA Neurol, 2016, 73:714-720.
[81] Boronat A, Gelfand JM, Gresa-Arribas N, Jeong HY, Walsh M, Roberts K, Martinez-Hernandez E, Rosenfeld MR, Balice-Gordon R, Graus F, Rudy B, Dalmau J. Encephalitis and antibodies to dipeptidyl-peptidase-like protein-6, a subunit of Kv4.2 potassium channels[J]. Ann Neurol, 2013, 73:120-128.
[82] Shojima Y, Nishioka K, Watanabe M, Jo T, Tanaka K, Takashima H, Noda K, Okuma Y, Urabe T, Yokoyama K, Hattori N. Clinical characterization of definite autoimmune limbic encephalitis: a 30-case series[J]. Intern Med, 2019, 58:3369-3378.
[83] Baumgartner A, Rauer S, Mader I, Meyer PT. Cerebral FDG-PET and MRI findings in autoimmune limbic encephalitis: correlation with autoantibody types[J]. J Neurol, 2013, 260:2744-2753.
[84] Liu X, Yu T, Zhao X, Li G, Lv R, Ai L, Wang Q. ^{18}F-fluorodeoxy-glucose positron emission tomography pattern and prognostic predictors in patients with anti-GABAB receptor encephalitis[J]. CNS Neurosci Ther, 2021.[Epub ahead of print]
[85] Laurido-Soto O, Brier MR, Simon LE, McCullough A, Bucelli RC, Day GS. Patient characteristics and outcome associations in AMPA receptor encephalitis[J]. J Neurol, 2019, 266:450-460.
[86] Masangkay N, Basu S, Moghbel M, Kwee T, Alavi A. Brain ^{18}F-FDG-PET characteristics in patients with paraneoplastic neurological syndrome and its correlation with clinical and MRI findings[J]. Nucl Med Commun, 2014, 35:1038-1046.
[87] Dalmau J, Geis C, Graus F. Autoantibodies to synaptic receptors and neuronal cell surface proteins in autoimmune diseases of the central nervous system[J]. Physiol Rev, 2017, 97:839-887.
[88] Probasco JC, Solnes L, Nalluri A, Cohen J, Jones KM, Zan E, Javadi MS, Venkatesan A. Decreased occipital lobe metabolism by FDG-PET/CT: an anti-NMDA receptor encephalitis biomarker[J]. Neurol Neuroimmunol Neuroinflamm, 2017, 5:e413.
[89] Wei YC, Tseng JR, Wu CL, Su FC, Weng WC, Hsu CC, Chang KH, Wu CF, Hsiao IT, Lin CP. Different FDG-PET metabolic patterns of anti-AMPAR and anti-NMDAR encephalitis: case report and literature review[J]. Brain Behav, 2020, 10:e01540.
[90] Ge J, Deng B, Guan Y, Bao W, Wu P, Chen X, Zuo C. Distinct cerebral ^{18}F-FDG PET metabolic patterns in anti-N-methyl-D-aspartate receptor encephalitis patients with different trigger factors[J]. Ther Adv Neurol Disord, 2021, 14:1756286421995635.
[91] Sabater L, Gaig C, Gelpi E, Bataller L, Lewerenz J, Torres-Vega E, Contreras A, Giometto B, Compta Y, Embid C, Vilaseca I, Iranzo A, Santamaría J, Dalmau J, Graus F. A novel non-rapid-eye movement and rapid-eye-movement parasomnia with sleep breathing disorder associated with antibodies to IgLON5: a case series, characterisation of the antigen, and post-mortem study[J]. Lancet Neurol, 2014, 13:575-586.
[92] Giannini G, Calandra-Buonaura G, Mastrolilli F, Righini M, Bacchi-Reggiani ML, Cecere A, Barletta G, Guaraldi P, Provini F, Cortelli P. Early stridor onset and stridor treatment predict survival in 136 patients with MSA[J]. Neurology, 2016, 87:1375-1383.

[93] Patterson KR, Dalmau J, Lancaster E. Mechanisms of Caspr2 antibodies in autoimmune encephalitis and neuromyotonia[J]. Ann Neurol, 2018, 83:40-51.
[94] Koneczny I, Yilmaz V, Lazaridis K, Tzartos J, Lenz TL, Tzartos S, Tüzün E, Leypoldt F. Common denominators in the immunobiology of IgG4 autoimmune diseases: what do glomerulonephritis, pemphigus vulgaris, myasthenia gravis, thrombotic thrombocytopenic purpura and autoimmune encephalitis have in common[J]? Front Immunol, 2021, 11: 605214.
[95] van Coevorden - Hameete MH, de Graaff E, Titulaer MJ, Hoogenraad CC, Sillevis Smitt PA. Molecular and cellular mechanisms underlying anti - neuronal antibody mediated disorders of the central nervous system[J]. Autoimmun Rev, 2014, 13:299-312.
[96] Gadoth A, Zekeridou A, Klein CJ, Thoreson CJ, Majed M, Dubey D, Flanagan EP, McKeon A, Jenkins SM, Lennon VA, Pittock SJ. Elevated LGI1 - IgG CSF index predicts worse neurological outcome[J]. Ann Clin Transl Neurol, 2018, 5:646-650.
[97] Li TR, Zhang YD, Wang Q, Shao XQ, Li ZM, Lv RJ. Intravenous methylprednisolone or immunoglobulin for anti - glutamic acid decarboxylase 65 antibody autoimmune encephalitis: which is better[J]? BMC Neurosci, 2020, 21:13.
[98] Parwani J, Ortiz JF, Alli A, Lalwani A, Ruxmohan S, Tamton H, Cuenca VD, Gonzalez D, Anwer F, Eissa - Garcés A, Alzamora IM, Paez M. Understanding seizures and prognosis of the extreme delta brush pattern in anti-N-methyl-D-aspartate (NMDA) receptor encephalitis: a systematic review[J]. Cureus, 2021, 13:e18154.
[99] de Montmollin E, Demeret S, Brulé N, Conrad M, Dailler F, Lerolle N, Navellou JC, Schwebel C, Alves M, Cour M, Engrand N, Tonnelier JM, Maury E, Ruckly S, Picard G, Rogemond V, Magalhaes É, Sharshar T, Timsit JF, Honnorat J, Sonneville R; ENCEPHALITICA Study Group. Anti - N - methyl - D - aspartate receptor encephalitis in adult patients requiring intensive care[J]. Am J Respir Crit Care Med, 2017, 195:491-499.
[100] Zhang Y, Liu G, Jiang M, Chen W, He Y, Su Y. Clinical characteristics and prognosis of severe anti - N - methyl - D - aspartate receptor encephalitis patients[J]. Neurocrit Care, 2018, 29:264-272.
[101] Mehr SR, Neeley RC, Wiley M, Kumar AB. Profound autonomic instability complicated by multiple episodes of cardiac asystole and refractory bradycardia in a patient with anti - NMDA encephalitis[J]. Case Rep Neurol Med, 2016, 2016:7967526.
[102] Li TR, Zhang YD, Wang Q, Shao XQ, Lyu DY, Lv RJ. Clinical characteristics and long - term prognosis of anti - LGI1 encephalitis: a single-center cohort study in Beijing, China[J]. Front Neurol, 2021, 12:674368.
[103] Li Y, Song F, Liu W, Wang Y. Clinical features of nine cases of leucine-rich glioma inactivated 1 protein antibody-associated encephalitis[J]. Acta Neurol Belg, 2021, 121:889-897.
[104] Society of Neurology, Chinese Medical Association. Consensus of Chinese experts on diagnosis and treatment of autoimmune encephalitis[J]. Zhonghua Shen Jing Ke Za Zhi, 2017, 50:91-98.[中华医学会神经病学分会. 中国自身免疫性脑炎诊治专家共识[J]. 中华神经科杂志, 2017, 50:91-98.]

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·小词典·

中英文对照名词词汇（四）

巨噬细胞炎性蛋白-1α
macrophage inflammatory protein-1α（MIP-1α）

聚合酶链反应 polymerase chain reaction（PCR）

抗甘氨酸受体抗体阳性伴强直和肌阵挛的进展性脑脊髓炎
glycine receptor antibody-associated encephalomyelitis with rigidity and myoclonus（PERM）

抗缪勒管激素 anti-Müllerian hormone（AMH）

抗逆转录病毒疗法 antiretroviral therapy（ART）

抗髓鞘少突胶质细胞糖蛋白免疫球蛋白G抗体相关疾病
myelin oligodendrocyte glycoprotein-IgG associated disorders（MOGAD）

抗原呈递细胞 antigen-presenting cell（APC）

抗中性粒细胞胞质抗体
anti-neutrophil cytoplasmic antibody（ANCA）

可逆性胼胝体压部病变综合征
reversible splenial lesion syndrome（RESLES）

可溶性Fas配体 soluble Fas ligand（sFasL）

快速眼动睡眠期行为障碍
rapid eye movement sleep behavior disorder（RBD）

扩展残疾状态量表 Expanded Disability Status Scale（EDSS）

酪氨酸蛋白激酶A5 tyrosine protein kinase A5（TrkA5）

酪氨酸激酶抑制剂 tyrosine kinase inhibitors（TKIs）

类固醇生成因子1 steroidogenic factor 1（SF-1）

离子型谷氨酸受体 ionotropic glutamate receptor（iGluR）

粒细胞集落刺激因子
granulocyte-colony stimulating factor（G-CSF）

粒细胞-巨噬细胞集落刺激因子
granulocyte-macrophage colony-stimulating factor（GM-CSF）

1-磷酸鞘氨醇 sphingosine-1-phosphate（S1P）

磷脂酶A2 phospholipase A2（PLA2）

滤泡辅助性T细胞 T follicular helper cell（Tfh）

卵泡刺激素 follicle stimulating hormone（FSH）

霉酚酸酯 mycophenolate mofetil（MMF）

免疫检查点抑制剂 immune checkpoint inhibitors（CPI）

免疫抑制疗法 immunosuppressive therapy（IST）

免疫组库测序 immune repertoire sequencing（IR-seq）

面-臂肌张力障碍发作
faciobrachial dystonic seizures（FBDS）

膜攻击复合物 membrane attack complex（MAC）

难治性癫痫 refractory epilepsy（RE）