

BÖLÜM 104

İMMÜN-ARACILI SEREBELLAR ATAKSİ

Murat CANSEVER¹
Türkan PATIROĞLU²

GİRİŞ

Serebellar ataksi (CA) gelişiminden sorumlu patogenetik etki hücre ölümüne yol açan immün aracılı disfonksiyon mekanizmasıdır.¹ İmmün mekanizmaya bağlı gelişen serebellar ataksiler (ICMA) karakteristik olarak; gluten ataksi (GA), paraneoplastik serebellar dejenerasyon (PCD), anti-glutamat dekarboksilaz 65 antikör-ilişkili serebellar ataksi (anti-GAD65-ilişkili CA), post-infeksiyöz serebellit ve opsoklonus miyoklonus sendromu (OMS) gibi çeşitli oto-immün temelli etiyojileri kapsar. Teröpatik yanıtın IMCA etiyojisine göre değiştiği düşünülmektedir.¹⁻⁹ CA yönetiminde farklılaşan etiyojilere, tedavi yöntemlerine ve sağlam doku kapasitesinin korunması olarak tanımlanan serebellar rezervin halen yeterli olduğu zaman aralığında erken immünoterapinin önemini vurgulayan klavuzlar yayınlanmıştır.¹⁰⁻¹² Yakın dönemli çalışmalarda IMCA patogeneziyle ilişkili birçok hücre ve antikör aracılı immün mekanizma ile ilgili yeni bulgular tanımlanmıştır. Bu çalışmalar erken tedavinin önemine ışık tutmakta olup ICMA klinik alt tiplerinin prevalansını ortaya koymaktadır.^{13,14} Bununla birlikte ataksilerin

büyük kısmına halen tanı konamamaktadır. Çünkü ICMA'nın progresif formları dejeneratif CA profillerini taklit eder. Klinik girişimlerdeki gecikmeler maalesef tedavi fırsatlarının kaybı ile ilişkilidir.^{13,14}

SINIFLAMA

Öykü

İmmün aracılı CA'leri ilk olarak 1868 yılında JM Charcot tanımlamıştır.¹ Bir sonraki tarihi mihenk taşı ise 1919 yılında B. Brouwer tarafından CA'ler ile malignansiler arasındaki ilişkinin tanımlanmasıdır.¹⁵ Son otuz yılda çeşitli malignansi tipleri ile CA arasında ki ilişki araştırılmıştır. Sonuç olarak çeşitli neoplazi kategorilerinde anti-Yo, anti-Hu, anti-Tr, anti-CV2, anti-Ri, anti-Ma2 ve anti-VGCC gibi spesifik oto-antikörler belirlenmiştir.³⁻⁸ Yüzyılın başında GA ve anti-GAD65 antikör ilişkili CA üzerine çeşitli çalışmalar yapılması dönüm noktası oluşturmuştur. Her iki klinik durumda da hafif serebellar atrofi varlığı veya atrofi olmaması ile oto-antikörlerin birlikteliği karakterizedir. MS ve PCD gibi klasik hastalıklar ile birlikte, klinik IMCA kategorileri artık ataksiyoloji olarak yerleşmiştir.^{1,10,16}

¹ Uzm. Dr., Kayseri Şehir Hastanesi, Çocuk Sağlığı ve Hastalıkları Kliniği, mcansever66@hotmail.com

² Prof. Dr., Ankara Lósante Hastanesi, Doku Tipleme ve Transplantasyon İmmünolojisi ve Çocuk Hematoloji/Onkoloji ve İmmünoloji Kliniği, turkanp@erciyes.edu.tr

KAYNAKLAR

1. Hadjivassiliou M. Immune-mediated acquired ataxias. *Handb. Clin. Neurol*, 2012;103:189-199.
2. Hadjivassiliou M, Grünewald R.A, Chattopadhyay A.K, Davies-Jones G.A, Gibson A, Jarratt J.A. et al. Clinical, radiological, neurophysiological, and neuropathological characteristics of gluten ataxia. *Lancet*, 1998;352(9140):1582-1585.
3. Graus F, Delattre J.Y, Antoine J.C, Dalmau J, Giometto B, Grisold W, et al. Recommended diagnostic criteria for paraneoplastic neurological syndromes. *J. Neurol. Neurosurg. Psychiatry*, 2004;75(8):1135-1140.
4. Dalmau J, Rosenfeld M.R. Paraneoplastic syndromes of the CNS. *Lancet Neurol*. 2008;7(4): 327-340.
5. Ducray F, Demarquay G, Graus F, Decullier E, Antoine J.C, Giometto, et al. Seronegative paraneoplastic cerebellar degeneration: the PNS Euronetwork experience. *Eur. J. Neurol*. 2014; 21(5):731-735.
6. Jarius S, Wildemann B. 'Medusa-head ataxia': the expanding spectrum of Purkinje cell antibodies in autoimmune cerebellar ataxia. Part 1: Anti-mGluR1, anti-Homer-3, anti-Sj/ITPR1 and anti-CARP VIII. *J Neuroinflammation*. 2015;12:166.
7. Jarius S, Wildemann B. 'Medusa head ataxia': the expanding spectrum of Purkinje cell antibodies in autoimmune cerebellar ataxia. Part 2: Anti-PK-C-gamma, anti-GluR-delta2, anti-Ca/ARHGAP26 and anti-VGCC. *J Neuroinflammation*. 2015;12:167.
8. Jarius S, Wildemann B. 'Medusa head ataxia': the expanding spectrum of Purkinje cell antibodies in autoimmune cerebellar ataxia. Part 3: Anti-Yo/CDR2, anti-Nb/AP3B2, PCA-2, anti-Tr/DNER, other antibodies, diagnostic pitfalls, summary and outlook. *J Neuroinflammation*. 2015;12:168.
9. Honnorat J, Saiz A, Giometto B, Vincent A, Brieva L, de Andres C, et al. Cerebellar ataxia with anti-glutamic acid decarboxylase antibodies: study of 14 patients. *Arch. Neurol.*, 2001, 58(2), 225-230.
10. Mitoma H, Manto M. The physiological basis of therapies for cerebellar ataxias. *Ther. Adv. Neurol. Disorder*. 2016;9(5):396-413.
11. Mitoma H, Manto M, Hampe C.S. Pathogenic Roles of Glutamic Acid Decarboxylase 65 Autoantibodies in Cerebellar Ataxias. *J Immunol Res*. 2017;2017:2913297.
12. Mitoma H, Manto M, Hampe C.S. Immune-mediated cerebellar ataxias: from bench to bedside. *Cerebellum Ataxias*, 2017;4:16.
13. Hadjivassiliou M, Martindale J, Shanmugarajah P, Grünewald R.A, Sarrigiannis P.G, Beauchamp, et al. Causes of progressive cerebellar ataxia: prospective evaluation of 1500 patients. *J. Neurol. Neurosurg. Psychiatry*, 2017;88(4):301-309.
14. Hadjivassiliou M. Advances in Therapies of Cerebellar Disorders: Immune-mediated Ataxias. *CNS Neurol Disord Drug Targets*. 2019;18(6):423-431.
15. Brouwer, B. Beitrag zur Kenntnis der chronischen diffusen Kleinhirnerkrankungen. *Neurol. Zentralbl*. 1919;38:674-682.
16. Hadjivassiliou M. Advances in Therapies of Cerebellar Disorders: Immune-mediated Ataxias. *CNS Neurol Disord Drug Targets*. 2019;18(6):423-431.
17. Mitoma H, Hadjivassiliou M, Honnorat J. Guidelines for treatment of immune-mediated cerebellar ataxias. *Cerebellum Ataxias*. 2015;2:14.
18. Hilberath JM, Schmidt H, Wolf GK. Steroid-responsive encephalopathy associated with autoimmune thyroiditis (SREAT): case report of reversible coma and status epilepticus in an adolescent patient and review of the literature. *Eur J Pediatr*. 2014;173(10):1263-73.
19. Melzer N, Golombeck KS, Gross CC, Meuth SG, Wiendl H. Cytotoxic CD8+ T cells and CD138+ plasma cells prevail in cerebrospinal fluid in non-paraneoplastic cerebellar ataxia with contactin-associated protein-2 antibodies. *J Neuroinflammation*. 2012;9:160.
20. Miske R, Gross CC, Scharf M, Golombeck KS, Hartwig M, Bhatia U, et al. Neurochondrin is a neuronal target antigen in autoimmune cerebellar degeneration. *Neurol Neuroimmunol Neuroinflamm*. 2016;4(1):e307.
21. Rostami A, Ciric B. Role of Th17 cells in the pathogenesis of CNS inflammatory demyelination. *J Neurol Sci*. 2013;333(1-2):76-87.
22. Danikowski KM, Jayaraman S, Prabhakar BS. Regulatory T cells in multiple sclerosis and myasthenia gravis. *J Neuroinflammation*. 2017;14(1):117.
23. Friesse MA, Fugger L. Pathogenic CD8(+) T cells in multiple sclerosis. *Ann Neurol*. 2009;66(2):132-41.
24. Melzer N, Golombeck KS, Gross CC, Meuth SG, Wiendl H. Cytotoxic CD8+ T cells and CD138+ plasma cells prevail in cerebrospinal fluid in non-paraneoplastic cerebellar ataxia with contactin-associated protein-2 antibodies. *J Neuroinflammation*. 2012;9:160.
25. Iorio R, Damato V, Evoli A, Gessi M, Gaudino S, Di Lazzaro V, et al. Clinical and immunological characteristics of the spectrum of GFAP autoimmunity: a case series of 22 patients. *J Neurol Neurosurg Psychiatry*. 2018;89(2):138-146.
26. Vojdani A. A Potential Link between Environmental Triggers and Autoimmunity. *Autoimmune Dis*. 2014;2014:437231.
27. Zaenker P, Gray ES, Ziman MR. Autoantibody Production in Cancer--The Humoral Immune Response toward Autologous Antigens in Cancer Patients. *Autoimmun Rev*. 2016;15(5):477-83.
28. Bei R, Masuelli L, Palumbo C, Modesti M, Modesti A. A common repertoire of autoantibodies is shared by cancer and autoimmune disease patients: Inflammation in their induction and impact on tumor growth. *Cancer Lett*. 2009;281(1):8-23.
29. Satoh M, Chan EK, Ho LA, Rose KM, Parks CG, Cohn RD, et al. Prevalence and sociodemographic correlates of antinuclear antibodies in the United States. *Arthritis Rheum*. 2012;64(7):2319-27.

30. Sørgjerd EP, Thorsby PM, Torjesen PA, Skorpen E, Kvaløy K, Grill V. Presence of anti-GAD in a non-diabetic population of adults; time dynamics and clinical influence: results from the HUNT study. *BMJ Open Diabetes Res Care*. 2015;3(1):e000076.
31. Hampe CS, Maitland ME, Gilliam LK, Phan TH, Sweet IR, Radtke JR, et al. High titers of autoantibodies to glutamate decarboxylase in type 1 diabetes patients: epitope analysis and inhibition of enzyme activity. *Endocr Pract*. 2013;19(4):663-8.
32. Chéramy M, Hampe CS, Ludvigsson J, Casas R. Characteristics of in-vitro phenotypes of glutamic acid decarboxylase 65 autoantibodies in high-titre individuals. *Clin Exp Immunol*. 2013;171(3):247-54.
33. Nakamura Y, Nakajima H, Hosokawa T, Yamane K, Ishida S, Kimura F. Acute Cerebellar Ataxia Associated with Anti-glutamic Acid Decarboxylase Antibodies Mimicking Miller Fisher Syndrome. *Intern Med*. 2018;57(2):269-271.
34. Saiz A, Blanco Y, Sabater L, González F, Bataller L, Casamitjana R, Ramió-Torrentà L, Graus F. Spectrum of neurological syndromes associated with glutamic acid decarboxylase antibodies: diagnostic clues for this association. *Brain*. 2008;131(Pt 10):2553-63.
35. Takenoshita H, Shizuka-Ikeda M, Mitoma H, Song S, Harigaya Y, Igeta Y, et al. Presynaptic inhibition of cerebellar GABAergic transmission by glutamate decarboxylase autoantibodies in progressive cerebellar ataxia. *J Neurol Neurosurg Psychiatry*. 2001;70(3):386-9.
36. Hadjivassiliou M, Davies-Jones GA, Sanders DS, Grünewald RA. Dietary treatment of gluten ataxia. *J Neurol Neurosurg Psychiatry*. 2003;74(9):1221-4.
37. Souayah N, Chin RL, Brannagan TH, Latov N, Green PH, Kokoszka A, Sander HW. Effect of intravenous immunoglobulin on cerebellar ataxia and neuropathic pain associated with celiac disease. *Eur J Neurol*. 2008;15(12):1300-3.
38. Hadjivassiliou M, Grünewald RA, Davies-Jones GA. Gluten sensitivity as a neurological illness. *J Neurol Neurosurg Psychiatry*. 2002;72(5):560-3.
39. Hadjivassiliou M, Sanders DS, Woodrooffe N, Williamson C, Grünewald RA. Gluten ataxia. *Cerebellum*. 2008;7(3):494-8.
40. Hadjivassiliou M, Grünewald RA, Sanders DS, Shanmugarajah P, Hoggard N. Effect of gluten-free diet on cerebellar MR spectroscopy in gluten ataxia. *Neurology*. 2017;89(7):705-709.
41. Sarrigiannis PG, Hoggard N, Aeschlimann D, Sanders DS, Grünewald RA, Unwin ZC, Hadjivassiliou M. Myoclonus ataxia and refractory coeliac disease. *Cerebellum Ataxias*. 2014;1:11.
42. Schuppan D, Junker Y, Barisani D. Celiac disease: from pathogenesis to novel therapies. *Gastroenterology*. 2009;137(6):1912-33.
43. Thomas H, Beck K, Adamczyk M, Aeschlimann P, Langley M, Oita RC, et al. Transglutaminase 6: a protein associated with central nervous system development and motor function. *Amino Acids*. 2013;44(1):161-77.
44. Höftberger R, Rosenfeld MR, Dalmau J. Update on neurological paraneoplastic syndromes. *Curr Opin Oncol*. 2015;27(6):489-95.
45. Demarquay G, Honnorat J. Clinical presentation of immune-mediated cerebellar ataxia. *Rev Neurol (Paris)*. 2011;167(5):408-17.
46. Voltz R. Paraneoplastic neurological syndromes: an update on diagnosis, pathogenesis, and therapy. *Lancet Neurol*. 2002;1(5):294-305.
47. Shams'ili S, Grefkens J, de Leeuw B, van den Bent M, Hooijkaas H, van der Holt B, et al. Paraneoplastic cerebellar degeneration associated with anti-neuronal antibodies: analysis of 50 patients. *Brain*. 2003;126(Pt 6):1409-18.
48. Lancaster E, Dalmau J. Neuronal autoantigens--pathogenesis, associated disorders and antibody testing. *Nat Rev Neurol*. 2012;8(7):380-90.
49. Sillevs Smitt PA, Manley GT, Posner JB. Immunization with the paraneoplastic encephalomyelitis antigen HuD does not cause neurologic disease in mice. *Neurology*. 1995;45(10):1873-8.
50. Carpentier AF, Rosenfeld MR, Delattre JY, Whalen RG, Posner JB, Dalmau J. DNA vaccination with HuD inhibits growth of a neuroblastoma in mice. *Clin Cancer Res*. 1998;4(11):2819-24.
51. Albert ML, Austin LM, Darnell RB. Detection and treatment of activated T cells in the cerebrospinal fluid of patients with paraneoplastic cerebellar degeneration. *Ann Neurol*. 2000;47(1):9-17.
52. Benyahia B, Liblau R, Merle-Béral H, Tourani JM, Dalmau J, Delattre JY. Cell-mediated autoimmunity in paraneoplastic neurological syndromes with anti-Hu antibodies. *Ann Neurol*. 1999;45(2):162-7.
53. Venkatraman A, Opal P. Paraneoplastic cerebellar degeneration with anti-Yo antibodies - a review. *Ann Clin Transl Neurol*. 2016;3(8):655-63.
54. Gebauer C, Pignolet B, Yshii L, Mauré E, Bauer J, Liblau R. CD4+ and CD8+ T cells are both needed to induce paraneoplastic neurological disease in a mouse model. *Oncoimmunology*. 2016;6(2):e1260212.
55. Okano HJ, Park WY, Corradi JP, Darnell RB. The cytoplasmic Purkinje onconeural antigen cdr2 down-regulates c-Myc function: implications for neuronal and tumor cell survival. *Genes Dev*. 1999;13(16):2087-97.
56. Sakai K, Kitagawa Y, Saiki S, Saiki M, Hirose G. Effect of a paraneoplastic cerebellar degeneration-associated neural protein on B-myb promoter activity. *Neurobiol Dis*. 2004;15(3):529-33.
57. Fukuda T, Motomura M, Nakao Y, Shiraiishi H, Yoshimura T, Iwanaga K, et al. Reduction of P/Q-type calcium channels in the postmortem cerebellum of paraneoplastic cerebellar degeneration with Lambert-Eaton myasthenic syndrome. *Ann Neurol*. 2003;53(1):21-8.
58. Ariño H, Gresa-Arribas N, Blanco Y, Martínez-Hernández E, Sabater L, Petit-Pedrol M, et al. Cerebellar

- ataxia and glutamic acid decarboxylase antibodies: immunologic profile and long-term effect of immunotherapy. *JAMA Neurol.* 2014;71(8):1009-16.
59. Fouka P, Alexopoulos H, Akrivou S, Trohatou O, Politis PK, Dalakas MC. GAD65 epitope mapping and search for novel autoantibodies in GAD-associated neurological disorders. *J Neuroimmunol.* 2015;281:73-7.
 60. Manto M, Honnorat J, Hampe CS, Guerra-Narbona R, López-Ramos JC, Delgado-García JM, et al. Disease-specific monoclonal antibodies targeting glutamate decarboxylase impair GABAergic neurotransmission and affect motor learning and behavioral functions. *Front Behav Neurosci.* 2015;9:78.
 61. Ishida K, Mitoma H, Wada Y, Oka T, Shibahara J, Saito Y, et al. Selective loss of Purkinje cells in a patient with anti-glutamic acid decarboxylase antibody-associated cerebellar ataxia. *J Neurol Neurosurg Psychiatry.* 2007;78(2):190-2.
 62. Ishida K, Mitoma H, Mizusawa H. Reversibility of cerebellar GABAergic synapse impairment induced by anti-glutamic acid decarboxylase autoantibodies. *J Neurol Sci.* 2008;271(1-2):186-90.
 63. Manto MU, Laute MA, Aguera M, Rogemond V, Pandolfo M, Honnorat J. Effects of anti-glutamic acid decarboxylase antibodies associated with neurological diseases. *Ann Neurol.* 2007;61(6):544-51.
 64. Blumkin L, Pranzatelli MR. Acquired ataxias, infectious and para-infectious. *Handb Clin Neurol.* 2012;103:137-46.
 65. Sivaswamy L. Approach to acute ataxia in childhood: diagnosis and evaluation. *Pediatr Ann.* 2014;43(4):153-9.
 66. Sawaiishi Y, Takada G. Acute cerebellitis. *Cerebellum.* 2002;1(3):223-8.
 67. Connolly AM, Dodson WE, Prenskey AL, Rust RS. Course and outcome of acute cerebellar ataxia. *Ann Neurol.* 1994;35(6):673-9.
 68. Hayashi T, Ichiyama T, Kobayashi K. A case of acute cerebellar ataxia with an MRI abnormality. *Brain Dev.* 1989;11(6):435-6.
 69. Ito H, Sayama S, Irie S, Kanazawa N, Saito T, Kowa H, et al. Antineuronal antibodies in acute cerebellar ataxia following Epstein-Barr virus infection. *Neurology.* 1994;44(8):1506-7.
 70. Armangué T, Sabater L, Torres-Vega E, Martínez-Hernández E, Ariño H, Petit-Pedrol M, et al. Clinical and Immunological Features of Opsoclonus-Myoclonus Syndrome in the Era of Neuronal Cell Surface Antibodies. *JAMA Neurol.* 2016;73(4):417-24.
 71. Klaas JP, Ahlskog JE, Pittock SJ, Matsumoto JY, Aksamit AJ, Bartleson JD, et al. Adult-onset opsoclonus-myoclonus syndrome. *Arch Neurol.* 2012;69(12):1598-607.
 72. Bataller L, Graus F, Saiz A, Vilchez JJ; Spanish Opsoclonus-Myoclonus Study Group. Clinical outcome in adult onset idiopathic or paraneoplastic opsoclonus-myoclonus. *Brain.* 2001;124(Pt 2):437-43.
 73. Pranzatelli MR, Travelstead AL, Tate ED, Allison TJ, Moticka EJ, Franz DN, et al. B- and T-cell markers in opsoclonus-myoclonus syndrome: immunophenotyping of CSF lymphocytes. *Neurology.* 2004;62(9):1526-32.
 74. Pranzatelli MR, Tate ED, Swan JA, Travelstead AL, Colliver JA, Verhulst SJ, et al. B cell depletion therapy for new-onset opsoclonus-myoclonus. *Mov Disord.* 2010;25(2):238-42.
 75. Mitoma H, Orimo S, Sodeyama N, Tamaki M. Paraneoplastic opsoclonus-myoclonus syndrome and neurofibrosarcoma. *Eur Neurol.* 1996;36(5):322.
 76. Wong AM, Musallam S, Tomlinson RD, Shannon P, Sharpe JA. Opsoclonus in three dimensions: ophthalmic, neuropathologic and modelling correlates. *J Neurol Sci.* 2001;189(1-2):71-81.
 77. Chekroud AM, Anand G, Yong J, Pike M, Bridge H. Altered functional brain connectivity in children and young people with opsoclonus-myoclonus syndrome. *Dev Med Child Neurol.* 2017;59(1):98-104.
 78. Mitoma H, Manto M, Hampe CS. Time Is Cerebellum. *Cerebellum.* 2018;17(4):387-391.