



BÖLÜM 14

KONJENİTAL DEMİYELİNİZAN HASTALIKLAR

Esen ÇİÇEKLİ¹
Saadet SAYAN²

GİRİŞ

Demyelinizan hastalıklar, santral ve periferik sinir sisteminde aksonları saran miyelin kılıfının, konjenital veya akkiz nedenlerle yıkımı uğraması sonucu gelişen, geniş bir klinik spektruma sahip hastalıklar toplamıdır.

Demyelinizan hastalıklar; otoimmun, enfeksiyon, toksik/metabolik, vasküler ve myelin metabolizmasının herediter hastalıkları şeklinde sınıflandırılabilir (1).

Konjenital demiyelinizan hastalıklarda genellikle oluşmuş miyelin kılıfının hasarlanması ziyade, miyelin kılıfının yapım aşamasında genetik bir defekt söz konusudur. Kliniğin ortaya çıkması genelde hastalığın erken evrelerinde görülür. Burada herediter miyelin hastalıklar alt başlıklar halinde inceleneciktir.

ADRENOLÖKODİSTROFİ (ALD)

Uzun zincirli yağ asidi metabolizmasında defekt ile ilişkili tablo, en yaygın kalitsal peroksizomal hastalıktır. Progresif seyirde; santral sinir sisteminde beyaz cevher lezyonları ve adrenal gland disfonksiyonu bulguları eşlik eder.

Santral sinir sisteminde genellikle korpus kallosum ve oksipitoparyat bölgede içine alan kranyal, nadiren de spinal kordda simetrik beyaz cevher lezyonları gözlenir. İnflamatuar süreç öncelikle miyelin kılıfı ve oligodendrosit hasa-

¹Uzm. Dr., Akyazı Devlet Hastanesi, Nöroloji Kliniği, esencirit@gmail.com

²Uzm. Dr., Sakarya Eğitim ve Araştırma Hastanesi, Nöroloji Kliniği, dr_sdt.86@hotmail.com

Ayrıca hastlığın medikal tedavisinde fenilalanin düzeyinin düşürülmesine yarayan sapropterin, uygun diyet tedavisine ek olarak kullanılabilmektedir. Ne yazık ki tüm hastalarda uygun tedavi yanıtı vermemektedir. 2018'de FDA tarafından onaylanan enjekte edilebilir bir pegile fenilalanin amonyak liyaz olan ve halen oldukça yeni olan terapötik pegvaliaz, hastlığın tedavisi için yeni bir umut oluşturmaktadır (75).

SONUÇ

Herediter demiyelinizan hastalıklar, genellikle miyelinin yapım aşamasında bir defektle karakterize, çoğunlukla enzim eksikliğine sekonder gelişen hastalıklardır. Tutulum yerine ve etkilenim şiddetine göre değişik klinik bulgu verebilirler. Tedavileri çok yüz güldürücü olmasa da genetik danışmanlık, erken tanı ve uygun destek tedavileri ile hastalık yönetimi mümkün olmakta, tanı ve tedavi yöntemlerine dair güncel çalışmalar devam etmektedir.

KAYNAKLAR

1. Daroff R.B, Jankovic J, Mazziotta J, Pomeroy LS. Bradley's Neurology in clinical practice,2 volume, seventh edition, page 1160
2. Powers JM, Liu Y, Moser AB et al. The inflammatory myelinopathy of adreno-leukodystrophy: cells, effector molecules, and pathogenetic implications. *J Neuropathol Exp Neurol.* 1992 Nov;51(6):630-43. doi: 10.1097/00005072-199211000-00007.
3. Ulrich J, Herschkowitz N, Heitz Pet al. Adrenoleukodystrophy. Preliminary report of a connatal case. Light- and electron microscopical, immunohistochemical and biochemical findings. *Acta Neuropathol.* 1978 Aug 7;43(1-2):77-83. doi: 10.1007/BF00685001.
4. Braverman NE, Raymond GV, Rizzo WB et al. Peroxisome biogenesis disorders in the Zellweger spectrum: An overview of current diagnosis, clinical manifestations, and treatment guidelines. *Mol Genet Metab.* 2016 Mar;117(3):313-21. doi: 10.1016/j.ymgme.2015.12.009.
5. Engelen M, Kemp S, Poll-The BT. X-linked adrenoleukodystrophy: pathogenesis and treatment. *Curr Neurol Neurosci Rep.* 2014 Oct;14(10):486. doi: 10.1007/s11910-014-0486-0.
6. Engelen M, Kemp S, de Visser M et al. X-linked adrenoleukodystrophy (X-ALD): clinical presentation and guidelines for diagnosis, follow-up and management. *Orphanet J Rare Dis.* 2012 Aug 13; 7:51. doi: 10.1186/1750-1172-7-51.
7. Steinberg SJ, Raymond GV, Braverman NE et al. Zellweger Spectrum Disorder. 2003 Dec 12 (updated 2020 Oct 29). In: Adam MP, Mirzaa GM, Pagon RA, Wallace SE, Bean LJH, Gripp KW, Amemiya A, editors. GeneReviews[®] (Internet). Seattle (WA): University of Washington, Seattle; 1993–2022.

8. Farrell DF. Neonatal adrenoleukodystrophy: a clinical, pathologic, and biochemical study. *Pediatr Neurol.* 2012 Nov;47(5):330-6. doi:10.1016/j.pediatrneurol.2012.07.006.
9. Alsaleem M, Saadeh L. Adrenoleukodystrophy. 2021 Nov 25. In: StatPearls (Internet). Treasure Island (FL): StatPearls Publishing; 2022 Jan-. PMID: 32965999.
10. Engelen M, Barbier M, Dijkstra IM et al. X-linked adrenoleukodystrophy in women: a cross-sectional cohort study. *Brain.* 2014 Mar;137(Pt 3):693-706. doi: 10.1093/brain/awt361. 24480483.
11. Molzer B, Kainz-Korschinsky M, Sundt-Heller R et al. Phytanic acid and very long chain fatty acids in genetic peroxisomal disorders. *J Clin Chem Clin Biochem.* 1989 May;27(5):309-14.
12. Boehm CD, Cutting GR, Lachtermacher MB et al. Accurate DNA- based diagnostic and carrier testing for X-linked adrenoleukodystrophy. *Mol Genet Metab.* 1999 Feb;66(2):128-36. doi: 10.1006/mgme.1998.2779.
13. Eichler F, Duncan C, Musolino PL et al. Hematopoietic Stem-Cell Gene Therapy for Cerebral Adrenoleukodystrophy. *N Engl J Med.* 2017 Oct 26;377(17):1630-1638. doi:10.1056/NEJMoa1700554.
14. Barth ML, Fensom A. Prevalence of common mutations in the arylsulphatase A gene in metachromatic leukodystrophy patients diagnosed in Britain. *Hum Genet* 1993; 91:73-7.
15. Tannesen T, Vrang C. Atypical metachromatic leukodystrophy? Problems with the biochemical diagnosis. *Hum Genet* 1984; 67:170-3
16. Von Figura K, Gieselmann V, Jaeken J. Metachromatic Leukodystrophy. In: Scriver CR, Beaudet AL, Sly WS, Valle D (eds). *The Metabolic and Molecular Basis of Inherited Disease.* 7th ed. New York: McGraw-Hill, 2001:3695-724.
17. Kohn H, Manowitz P. Neuropsychological deficits in obligatory heterozygotes for metachromatic leukodystrophy. *Hum Genet* 1988; 79:8-12.
18. Sevin C, Aubourg P, Cartier N. Enzyme, cell and genebased therapies for metachromatic leukodystrophy. *J Inherit Metab Dis* 2007; 30:175-183.
19. Vanderver A, Prust M, Tonduti D et al; GLIA Consortium. Case definition and classification of leukodystrophies and leukoencephalopathies. *Mol Genet Metab.* 2015 Apr;114(4):494-500. doi: 10.1016/j.ymgme.2015.01.006.
20. Ługowska A, Ponińska J, Krajewski P et al. Population carrier rates of pathogenic ARSA gene mutations: is metachromatic leukodystrophy underdiagnosed? *PLoS One.* 2011;6(6): e20218. doi: 10.1371
21. Bradley WG, Daroff RB, Fenichel GM, Marsden CD (eds). *Neurology in Clinical Practice.* 3rd ed. Boston: Butterworth-Heinemann, 2000:1661-2, 1741-2, 2076-7.
22. Cesani M, Lorioli L, Grossi S et al. Mutation Update of ARSA and PSAP Genes Causing Metachromatic Leukodystrophy. *Hum Mutat.* 2016 Jan;37(1):16-27. doi: 10.1002/humu.22919.
23. Polten A, Fluharty AL, Fluharty CB et al. Molecular basis of different forms of metachromatic leukodystrophy. *N Engl J Med* 1991; 324:18-22.
24. Kolnikova M, Jungova P, Skopkova M et al. Late Infantile Metachromatic Leukodystrophy Due to Novel Pathogenic Variants in the PSAP Gene. *J Mol Neurosci.* 2019 Apr;67(4):559-563. doi: 10.1007/s12031-019-1259-7.

25. Kehrer C, Blumenstock G, Gieselmann V et al. GERMAN LEUKONET. The natural course of gross motor deterioration in metachromatic leukodystrophy. *Dev Med Child Neurol.* 2011 Sep;53(9):850-855. doi: 10.1111/j.1469-8749.2011.04028.x.
26. Lamichhane A, Rocha Cabrero F. Metachromatic Leukodystrophy. 2021 Nov 13. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2022 Jan-. PMID: 32809579.
27. Gieselmann V. Metachromatic leukodystrophy: genetics, pathogenesis and therapeutic options. *Acta Paediatr Suppl* 2008; 97:15-21
28. Barth ML, Fensom A, Harris A. The arylsulphatase A gene and molecular genetics of metachromatic leucodystrophy. *J Med Genet* 1994; 31:663-6.
29. Chauhan NS, Sharma M, Bhardwaj A. Classical case of late-infantile form of metachromatic leukodystrophy. *J Neurosci Rural Pract.* 2016 Jul-Sep;7(3):473-5. doi: 10.4103/0976-3147.181482.
30. Harrington M, Whalley D, Twiss J et al. Insights into the natural history of metachromatic leukodystrophy from interviews with caregivers. *Orphanet J Rare Dis.* 2019 Apr 29;14(1):89. doi: 10.1186/s13023-019-1060-2.
31. Schiffmann R, van der Knaap MS. Invited article: an MRI-based approach to the diagnosis of white matter disorders. *Neurology.* 2009 Feb 24;72(8):750-9. doi: 10.1212/01.wnl.0000343049.00540.c8.
32. Selcuki D, Bakar E, Kömürcülü N. Nadir görülen bir geç distoni nedeni: erişkin başlangıçlı metakromatik lökodistrofi (olgu sunumu). *Gülhane Tp Dergisi* 2009; 51:45-8
33. Hong X, Kumar AB, Daiker J et al. Leukocyte and Dried Blood Spot Arylsulfatase A Assay by Tandem Mass Spectrometry. *Anal Chem.* 2020 May 5;92(9):6341-6348. doi: 10.1021/acs.analchem.9b05274.
34. Krabbe K. A new familial, infantile form of diffuse brain-sclerosis, *Brain* 39 (1916) 74–114
35. Bradbury AM, Bongarzone ER, Sands MS. Krabbe disease: New hope for an old disease. *Neurosci Lett.* 2021 May 1;752:135841. doi: 10.1016/j.neulet.2021.135841.
36. Turgeon CT, Orsini JJ, Sanders KA et al. Measurement of psychosine in dried blood spots—a possible improvement to newborn screening programs for Krabbe disease. *J Inherit Metab Dis.* 2015 Sep;38(5):923-9.
37. Suzuki K, Suzuki Y. Globoid cell leucodystrophy (Krabbe's disease): deficiency of galactocerebroside beta-galactosidase. *Proc Natl Acad Sci U S A.* 1970 Jun;66(2):302-9.
38. Orsini JJ, Escolar ML, Wasserstein MP, et al. Krabbe Disease. 2000 Jun 19 [Updated 2018 Oct 11]. In: Adam MP, Mirzaa GM, Pagon RA, et al., editors. GeneReviews® [Internet]. Seattle (WA): University of Washington, Seattle; 1993-2022.
39. Komatsuzaki S, Zielonka M, Mountford WK et al. Clinical characteristics of 248 patients with Krabbe disease: quantitative natural history modeling based on published cases. *Genet Med.* 2019 Oct;21(10):2208-2215
40. Duffner PK, Barczykowski A, Jalal K et al. Early infantile Krabbe disease: results of the World-Wide Krabbe Registry. *Pediatr Neurol.* 2011 Sep;45(3):141-8.
41. Brockmann K, Dechent P, Wilken B et al. Proton MRS profile of cerebral metabolic abnormalities in Krabbe disease. *Neurology.* 2003 Mar 11;60(5):819-25.
42. Farrell DF, Percy AK, Kaback MM et al. Globoid cell (Krabbe's) leukodystrophy: heterozygote detection in cultured skin fibroblasts. *Am J Hum Genet.* 1973 Nov;25(6):604-9.

43. Camelier M, Civallero G, De Mari J et al. Galactocerebrosidase assay on dried-leukocytes impregnated in filter paper for the detection of Krabbe disease. *Clin Chim Acta.* 2015 Jan 01; 438:178-80.
44. Allewelt H, Taskindoust M, Troy J et al. Long-Term Functional Outcomes after Hematopoietic Stem Cell Transplant for Early Infantile Krabbe Disease. *Biol Blood Marrow Transplant.* 2018 Nov;24(11):2233-2238.
45. Escolar ML, Poe MD, Martin HR et al. A staging system for infantile Krabbe disease to predict outcome after unrelated umbilical cord blood transplantation. *Pediatrics.* 2006 Sep;118(3): e879-89.
46. Yoshida T, Sasaki M, Yoshida M et al. Alexander Disease Study Group in Japan. Nationwide survey of Alexander disease in Japan and proposed new guidelines for diagnosis. *J Neurol.* 2011 Nov;258(11):1998-2008. doi: 10.1007/s00415-011-6056-3. Epub 2011 May 1. PMID: 21533827.
47. Kuhn J, Cascella M. Alexander Disease. 2022 Feb 5. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2022 Jan-. PMID: 32965913.
48. Eng LF, Ghirnikar RS, Lee YL. Glial fibrillary acidic protein: GFAP-thirty- one years (1969- 2000). *Neurochem Res.* 2000 Oct;25(9-10):1439-51. doi: 10.1023/a:1007677003387.
49. Nielsen AL, Jørgensen P, Jørgensen AL. Mutations associated with a childhood leukodystrophy, Alexander disease, cause deficiency in dimerization of the cytoskeletal protein GFAP. *J Neurogenet.* 2002 Jul-Sep;16(3):175-9. doi: 10.1080/01677060215305.
50. Hagemann TL, Powers B, Mazur C et al. Antisense suppression of glial fibrillary acidic protein as a treatment for Alexander disease. *Ann Neurol.* 2018 Jan;83(1):27-39. doi: 10.1002/ana.25118.
51. Springer S, Erlewein R, Naegele T et al. Alexander disease classification revisited and isolation of a neonatal form. *Neuropediatrics.* 2000 Apr;31(2):86-92. doi: 10.1055/s-2000-7479. PMID: 10832583.
52. Bassuk AG, Joshi A, Burton BK et al. Alexander disease with serial MRS and a new mutation in the glial fibrillary acidic protein gene. *Neurology.* 2003 Oct 14;61(7):1014-5. doi:10.1212/01.wnl.0000082440.42354.d0.
53. Pareyson D, Fancellu R, Mariotti C et al. Adult-onset Alexander disease: a series of eleven unrelated cases with review of the literature. *Brain.* 2008 Sep;131(Pt 9):2321-31. doi:10.1093/brain/awn178.
54. Adang LA, Sherbini O, Ball L et al. Global Leukodystrophy Initiative (GLIA) Consortium. Revised consensus statement on the preventive and symptomatic care of patients with leukodystrophies. *Mol Genet Metab.* 2017 Sep;122(1-2):18-32. doi: 10.1016/j.ymgme.2017.08.006.
55. Hershfield JR, Pattabiraman N, Madhavarao CN et al. "Mutational analysis of aspartoacylase: implications for Canavan disease". *Brain Research.* May 2007. 1148: 1-14.
56. Zayed H. Canavan disease: an Arab scenario. *Gene.* 2015 Apr 10;560(1):9-14.
57. Matalon R., Michals K., Sebesta D. et al. Aspartoacylase deficiency and N-acetylaspartic aciduria in patients with Canavan disease. *Am. J. Med. Genet.* (1988). 29, 463-471. 10.1002/ajmg.1320290234

58. Tacke U, Olbrich H, Sass JO et al. Possible genotype-phenotype correlations in children with mild clinical course of Canavan disease. *Neuropediatrics*. 2005;36:252–5.
59. Matalon R, Michals K, Kaul R. Canavan disease: from spongy degeneration to molecular analysis. *J Pediatr*. 1995;127:511–7.
60. Karimzadeh P, Jafari N, Nejad Biglari H, et al. The clinical features and diagnosis of Canavan's disease: A case series of Iranian patients. *Iran J Child Neurol*. 2014;8:66–71.
61. Takaichi Y, Chambers JK, Shiroma-Kohyama M et al. Feline Spongy Encephalopathy With a Mutation in the ASPA Gene. *Vet Pathol*. 2021 Jul;58(4):705-712. doi: 10.1177/03009858211002176
62. Matalon R, Delgado L, Michals-Matalon K. Canavan Disease. 1999 Sep 16 [updated 2018 Sep 13]. In: Adam MP, Mirzaa GM, Pagon RA, Wallace SE, Bean LJH, Gripp KW, Amemiya A, editors. *GeneReviews®* [Internet]. Seattle (WA): University of Washington, Seattle; 1993–2022
63. Hoshino H, Kubota M. Canavan disease: clinical features and recent advances in research. *Pediatr Int*. 2014 Aug;56(4):477-83.
64. Inoue K. Pelizaeus-Merzbacher Disease: Molecular and Cellular Pathologies and Associated Phenotypes. *Adv Exp Med Biol*. 2019; 1190:201-216.
65. Osório MJ, Goldman SA. Neurogenetics of Pelizaeus-Merzbacher disease. *Handb Clin Neurol*. 2018; 148:701-722. doi: 10.1016/B978-0-444-64076-5.00045-4
66. Garbern J, Hobson G. Prenatal diagnosis of Pelizaeus-Merzbacher disease. *Prenat Diagn*. 2002 Nov;22(11):1033-5. doi: 10.1002/pd.465.
67. Barkovich AJ, and Raybaud C. (2012). *Pediatric Neuroimaging* (Lippincott Williams & Wilkins)
68. Casey L. Caring for children with phenylketonuria. *Can Fam Physician*. 2013 Aug;59 (8):837-40.
69. Blau N, van Spronsen FJ & Levy HL Phenylketonuria. *Lancet* 376, 1417–1427 (2010)
70. de Groot MJ, Hoeksma M, Blau N et al. Pathogenesis of cognitive dysfunction in phenylketonuria: review of hypotheses. *Mol. Genet. Metab* 99 (Suppl 1), 86–89 (2010)
71. Jaulent P, Charriere S, Feillet F et al. Neurological manifestations in adults with phenylketonuria: new cases and review of the literature. *J Neurol*. 2020 Feb;267(2):531-542. doi: 10.1007/s00415-019-09608-2.
72. Pilotto A, Blau N, Leks E et al. Cerebrospinal fluid biogenic amines depletion and brain atrophy in adult patients with phenylketonuria. *J Inherit Metab Dis*. 2019 May;42(3):398-406. doi:10.1002/jimd.12049.
73. van Spronsen FJ, Blau N, Harding C et al. Phenylketonuria. *Nat Rev Dis Primers*. 2021 May 20;7(1):36. doi: 10.1038/s41572-021-00267-0
74. van Wegberg AMJ et al. The complete European guidelines on phenylketonuria: diagnosis and treatment. *Orphanet J. Rare Dis* 12, 162 (2017).
75. Burton BK, Longo N, Vockley J et al. PAL-002 and PAL-004 Investigators. Pegvaliase for the treatment of phenylketonuria: Results of the phase 2 dose-finding studies with long-term follow-up. *Mol Genet Metab*. 2020 Aug;130(4):239-246. doi: 10.1016/j.ymgme.2020.06.006.