

Bölüm 15

OPTİK NÖRİT

Hatice DALDAL¹

GİRİŞ

Optik nörit, genellikle 18-45 yaş aralığında genç erişkinleri etkileyen optik sinirin inflamasyonudur (1). Tipik olarak sıklıkla genç erişkin kadınlarında görülen, unilateral, spontan düzelen hafif orta derecede ağrılı görme kaybı ile karakterizedir. Optik nörit çoğunlukla idiyopatik olsa da demiyelinizan, sistemik otoimmün, enfeksiyöz, paraenfeksiyöz hastalıklar gibi bir çok heterojen etyolojiye sahiptir. Optik sinire izole bir şekilde monofazik, polifazik olabilir veya Multipl Skleroz (MS), Nöromiyelitis optika (NMO) gibi santral sinir sisteminin (SSS) demiyelinizan hastalığı ile ilişkili olabilir (1). Demiyelinizan hastalıklara benzer şekilde SLE, Sjögren, sarkoidoz gibi sistemik hastalıklar da belirti, bulgu vermeden önce izole optik nörit şeklinde görülebilmektedir. Etyolojiye göre klinik özellikler değişmektedir. Bu yüzden optik nöritin klinik özelliklerini, laboratuar, MRG, görme alanı bulgularını anlamak ayırıcı tanıya gitmek açısından çok önemlidir. Hasta akut izole optik nörit ile geldiğinde tipik tedavi 3 gün 1gr/gün IV metilprednizolon, sonrasında 11 gün 1mg/kg/gün oral prednizon şeklindedir. Başlangıçta primer tedavide oral prednizon rekürensi artırdığı için kullanılmamalı, öncelikle IV steroid tedavisi uygulanmalıdır. Taniya göre tedavide immünsüpresan ilaçlar eklenebilmektedir. Tedavi stratejisi açısından optik nöritin değişik tiplerinin tanınması ve tipik atipik ayrimı yapılması oldukça önemlidir, çünkü bir hastalık için kullanılan antienflamatuar ajan diğer hastalık için kullanılırsa hastalığın alevlenmesine neden olabilmektedir.

EPİDEMİYOLOJİ

Optik nörit insidansı yılda 5/100.000'dir. Ortalama başlangıç yaşı 36'dır; 18 yaşındaki veya 50 yaşındaki kişilerde nadir görülür (2,3,4). Hastaların %

¹ Dr. Öğr. Üyesi, Uşak Üniversitesi Eğitim ve Araştırma Hastanesi, drhdaldal@hotmail.com

sıklıkla genç erişkinlerde, perinöritte ise geniş aralıktadır. MS ile ilişki değerlendirildiğinde ise; optik nörit MS gelişimi için risk faktörü iken optik perinörit MS ile ilişkilendirilmemiştir (150).

SONUÇ

Sonuç olarak, optik nöritte başvuruda; yaş, görme kayıp hızı, göz hareketleri ile ağrı olup olmadığı, sistemik hastalık sorgulamasını içeren detaylı bir anamnez alınmalı, RAPD, renkli görme, dilate fundus muayenesi yapılmalı, ilk atakta veya atipik olan olguda kontrastlı beyin, orbita, spinal MRG çekimi yapılmalıdır, ayırcı tanı için tam kan, sedimentasyon, CRP istenmelidir. Gerekli görüldüğünde atipik durumlarda atipik optik nörit yapan hastalıklara özgü testler istenmelidir. Son dönemde NMO, MOG, paraneoplastik optik nöropati dikkat çekmektedir, bunlara özgü otoantikorlar gerekli görüldüğünde istenmelidir. Ayrıca sarkoidoz, SLE, Sjögren, Behçet hastalığı gibi sistemik hastalıklara özgü gerekli tetkikler de yapılmalıdır. Optik nöritlerde klinik spektrumu oldukça farklı hastalıklar görülmektedir. Tipik, atipik optik nörit ayrimı tanı, takip ve tedavi açısından çok önem arz etmektedir.

KAYNAKLAR

1. Abou Zeid N, Bhatti MT. Acute inflammatory demyelinating optic neuritis: evidence-based visual and neurological considerations. *Neurologist*. 2008;14(4):207-23.
2. Beck RW, Clearly PA, Aderson MM, et al. A randomized, controlled trial of corticosteroids in the treatment of acute optic neuritis. The Optic Neuritis Study Group. *N Engl J Med* 1992;326:581-8
3. Langer-Gould A, Brara SM; Beaber BE, et al. The incidence of clinically isolated syndrome in a multi-ethnic cohort. *J Neurol* 2014;261:1349-55
4. Martinez-Lapiscina EH, Fraga-Pumar E, Pastor X, et al. Is the incidence of optic neuritis rising? An epidemiological study in Barcelona (Spain), 2008-2012. *J Neurol* 2014;261(4):759-67 doi: 10.1007/s00415-014-7266-2
5. Hoorbakht H, Bagherkashi F. Optic neuritis, its differential diagnosis and management. *Open Ophthalmol J*. 2012;6:65-72.
6. Shams PN, Plant GT. Optic neuritis: a review. *Int MS J*. 2009; 16(3):82-9.
7. Dooley MC, Foroozan R. Optic neuritis. *J Ophthalmic Vis Res*. 2010;5(3):182-7.
8. Voss E, Raab P, Trebst C, Stangel M. Clinical approach to optic neuritis: pitfalls, red flags and differential diagnosis. *Ther Adv Neurol Disord*. 2011;4(2):123-34.
9. Menon V, Saxena R, Misra R, Phuljhele S. Management of optic neuritis. *Indian J Ophthalmol*. 2011;59(2):117-22.
10. Pau D, Al Zubidi N, Yalamanchili S, Plant GT, Lee AG. Optic Neuritis Eye. 2011;25(7):833-42.
11. Balcer LJ. Clinical practice. Optic neuritis. *N Engl J Med*. 2006; 354(12):1273-80.
12. Ayuso Blanco T, Aliseda D, Ajuria I, Zandio B, Mayor S, Navarro MC. Inflammatory optic neuritis. *An Sist Sanit Navar*. 2009;32(2): 249-63.
13. Hickman SJ, Dalton CM, Miller DH, Plant GT. Management of acute optic neuritis. *Lancet*. 2002;360(9349):1953-62.
14. Morrow MJ, Wingerchuk D: Neuromyelitis optica. *J Neuroophthalmol* 2012;32:154-66.
15. Kidd DP, Plant GT. Optic neuritis. In: Kidd DP, Newman NJ, Bioussse V eds. *Neuro-Ophthalmology*.

- mology.1st ed. Philadelphia: Elsevier;2008;134-52.
- 16. Cleary PA, Beck RW, Bourgue LB, et al. Visual symptoms after optic neuritis results from the optic neuritis treatment trial. *J Neuroophthalmol.* 1997;17:18-23.
 - 17. Jung JJ, Baek SH, Kim US. Analysis of the causes of optic disc swelling. *Korean J Ophthalmol.* 2011;25(1):33-6
 - 18. Agostoni E, Frigerio A, Protti A. Controversies in optic neuritis pain diagnosis. *Neurol Sci* 2005;26(2):75-8
 - 19. Katz B. The dyschromatopsia of optic neuritis: a descriptive analysis of data from the optic neuritis treatment trial. *Trans Am Ophthalmol Soc.* 1995;93:685-708.
 - 20. Silverman SE, Hart WM Jr, Gordon MO, et al. The dyschromatopsia of optic neuritis is determined in part by the foveal/perifoveal distribution of visual field damage. *Invest Ophthalmol Vis Sci.* 1990;31(9):1895-902
 - 21. Foroozan R, Buono LM, Savino PJ, et al. Acute demyelinating optic neuritis. *Curr Opin Ophthalmol* 2002;13(6):375-80.
 - 22. Fraser CL, Davagnanam I, Radon M, et al. The time course and phenotype of Uhthoff phenomenon following optic neuritis. *Mult Scler* 2012;18(7):1042-4.
 - 23. Park K, Tanaka K, Tanaka M: Uhthoff's phenomenon in multiple sclerosis and neuromyelitis optica. *Eur Neurol* 2014;72:153-6.
 - 24. Sefi Yurdakul N. Nörooftalmolojik hastalıkların tanısında görme keskinliği, kontrast duyarlılık, karanlık adaptasyon, fotostres testi, pulfrich fenomeni ve stereopsis. *Turkiye Klinikleri J Ophthalmol-Special Topics* 2014;7(3):1-5
 - 25. Levatin P, Prasloski PF, Collen MF. The swinging flashlight test in multiphasic screening for eye disease. *Can J Ophthalmol* 1973;8(2):356-60.
 - 26. Wilhelm H. Neuro-ophthalmology of pupillary function-practical guidelines. *J Neurol* 1998; 245(9):573-83.
 - 27. Cox TA. Initial pupillary constriction in the alternating light test. *Am J Ophthalmol* 1986; 101(1):120-1.
 - 28. Cox TA. Pupillary escape. *Neurology* 1992; 42(7):1271-3.
 - 29. Toosy AT, Mason DF, Miller DH. Optic neuritis. *Lancet Neurol.* 2014;13(1):83-99. doi: 10.1016/S1474-4422(13)70259-X.
 - 30. Costello F, Inflammatory Optic Neuropathies. *Neuro-ophthalmology* 2014;20:816-37 doi: 10.1212/01.CON.0000453316.60013.52
 - 31. Optic Neuritis Study Group. The clinical profile of optic neuritis. Experience of the Optic Neuritis Treatment Trial. *Arch Ophthalmol.* 1991;109(12):1673-8.
 - 32. Savino PJ, Sergott RC, Moster ML. (2008) Neuro-Ophthalmology. Ehlers JP, Shah CP, Fenton GL, Hoskins EN, Shelsta HN. (Eds) *The Wills Eye Manual: Office and Emergency Room Diagnosis and Treatment of Eye Disease - 5th Edition* p251-2. Philadelphia
 - 33. Kansu T. 2012 Optic Neuritis. Joseph I Maguire, Ann P Murchison, Edward A Jaeger (Eds) *Wills Eyes Institute 5 Minute Ophthalmology Consult* p 494-5. Philadelphia: Lippincott Williams & Wilkins Wolters Kluwer.
 - 34. Lim YM, Pyun SY, Lim HT, et al. First-ever optic neuritis: distinguishing subsequent neuromyelitis optica from multiple sclerosis. *Neurol Sci.* 2014;35(5):781-3
 - 35. Beck RW. The Optic Neuritis Treatment Trial. *Arch Ophthalmol.* 1988;106(8):1051-3.
 - 36. Optic Neuritis Study Group. Visual function 15 years after optic neuritis: a final follow-up report from the Optic Neuritis Treatment Trial. *Ophthalmology.* 2008;115(6):1079-82.
 - 37. The Optic Neuritis Study Group. Multiple sclerosis risk after optic neuritis: Final optic neuritis treatment trial follow-up. *Arch Neurol.* 2008;65(6):727-32. doi: 10.1001/archneur.65.6.727
 - 38. Wang IH, Lin SY, Woung LC, et al. Clinical prospective study of visual function in patients with acute optic neuritis. *J Formos Med Assoc.* 2013;112(2):87-92. doi: 10.1016/j.jfma.2012.02.001.
 - 39. Beck RW, Gal RL, Bhatti MT, et al. Optic Neuritis Study Group. Visual function more than 10 years after optic neuritis: experience of the optic neuritis treatment trial. *Am J Ophthalmol.* 2004;137(1):77-83.

40. Balcer LJ, Miller DH, Reingold SC, et al. Vision and vision-related outcome measures in multiple sclerosis. *Brain*. 2015;138:11-27. doi: 10.1093/brain/awu335.
41. Lublin FD, Miller AE. Multiple sclerosis and other inflammatory demyelinating diseases of the central nervous system. Bradley WG, Daroff RB, Fenichel GM, Jankovic J, eds. *Neurology in Clinical Practice* (5th ed). Philadelphia; Elsevier; 2008;1584-614.
42. Miller DH, Weinshenker BG, Filippi M, et al. Differential diagnosis of suspected multiple sclerosis: a consensus approach. *Multiple Sclerosis* 2008;14:1157-74
43. Pineles SL, Birch EE, Talman LS, et al. One eye or two: a comparison of binocular and monocular low-contrast acuity testing in multiple sclerosis. *Am J Ophthalmol* 2011;152(1):133-40 doi: 10.1016/j.ajo.2011.01.023.
44. Jasse L, et al. Persistent visual impairment in multiple sclerosis: prevalence, mechanisms and resulting disability. *Mult Scler J* 2013;19:1618-26.
45. Cole SR, Beck RW, Moke PS, et al. The National Eye Institute Visual Function Questionnaire: experience of the ONTT. Optic Neuritis Treatment Trial. *Invest Ophthalmol Vis Sci*. 2000;41(5):1017-21.
46. The Optic Neuritis Study Group. High and low risk profiles for the development of multiple sclerosis within 10 years after optic neuritis. *Arch Ophthalmol* 2003;121:944-9.
47. Keltner JL, Johnson CA, Spurr JO, et al. Baseline Visual Field Profile of Optic Neuritis. The Experience of the Optic Neuritis Treatment Trial. *Arch Ophthalmol*. 1993;111(2):231-4. doi:10.1001/archophth.1993.01090020085029
48. Keltner JL, Johnson CA, Spurr JO, et al. Comparison of central and peripheral visual field properties in the Optic Neuritis Treatment Trial. *Am J Ophthalmol* 1999;128(5):543-53.
49. Lightman S, McDonald WI, Bird AC, et al. Retinal venous sheathing in optic neuritis. Its significance for the pathogenesis of multiple sclerosis. *Brain* 1987;110(2):405-14.
50. Polman C.H., Reingold S.C., Banwell B., Clanet M., Cohen J.A., Filippi M. Diagnostic criteria for multiple sclerosis: 2010 revisions to the McDonald criteria. *Ann. Neurol.* 2011;69(2):292-302.
51. Parisi V, Manni G, Spadaro M et al. Correlation between morphological and functional retinal impairment in multiple sclerosis patients. *Invest Ophthalmol Vis Sci*. 1999;40:2520-7.
52. Trip SA, Schlottmann PG, Jones SJ et al. Retinal nerve fiber layer axonal loss and visual dysfunction in optic neuritis. *Ann Neurol*. 2005;58:383-91.
53. Siger M, Dziegielewski K, Jasek L et al. Optical coherence tomography in multiple sclerosis: thickness of the retinal nerve fiber layer as a potential measure of axonal loss and brain atrophy. *J Neurol*. 2008;255:1555-60.
54. Daldal H, Tök ÖY, Şengeze N, et al. Multipl sklerozda retina sinir lifi tabakası kalınlığı Türk Oftalmoloji Dergisi 2011;41(1):1-5 DOI: 10.4274/tjo.41.01
55. Kupersmith MJ, Kardon R, Durbin M, et al. Scanning laser polarimetry reveals status of RNFL integrity in eyes with optic nerve head swelling by OCT. *Invest Ophthalmol Vis Sci*. 2012;53(4):1962-70. doi: 10.1167/iovs.11-9339.
56. Gelfand JM, Nolan R, Schwartz DM, et al. Microcystic macular oedema in multiple sclerosis is associated with disease severity. *Brain*. 2012;135(6):1786-93.
57. Saidha S, Sotirchos ES, Ibrahim MA, et al. Microcystic macular oedema, thickness of the inner nuclear layer of the retina, and disease characteristics in multiple sclerosis: a retrospective study. *Lancet Neurol*. 2012 Nov; 11(11):963-72.
58. Kaufhold F, Zimmermann H, Schneider E, et al. Optic neuritis is associated with inner nuclear layer thickening and microcystic macular edema independently of multiple sclerosis. *PLoS One*. 2013;8(8):e71145.
59. Klistorner A, Arvind H, Nguyen T, et al. Multifocal VEP and OCT in optic neuritis: a topographical study of the structure-function relationship. *Doc Ophthalmol*. 2009;118(2):129-37.
60. Henderson AP, Altmann DR, Trip SA, et al. Early factors associated with axonal loss after optic neuritis. *Ann Neurol*. 2011;70(6):955-63.
61. Petzold A, Plant GT. The diagnostic and prognostic value of neurofilament heavy chain levels

- in immune-mediated optic neuropathies. *Mult Scler Int* 2012;2012:217-802
- 62. Moster S, Wilson JA, Galetta SL, et al. The King-Devick (K-D) test of rapid eye movements: a bedside correlate of disability and quality of life in MS. *J Neurol Sci*. 2014;343(1-2):105-9.
 - 63. Finke C, Pech LM, Sömmer C, et al. Dynamics of saccade parameters in multiple sclerosis patients with fatigue. *J Neurol*. 2012;259(12):2656-63.
 - 64. Serra A, Skelly MM, Jacobs JB, et al. Improvement of internuclear ophthalmoparesis in multiple sclerosis with dalfampridine. *Neurology*. 2014 Jul 8; 83(2):192-4.
 - 65. Zein G, Berta A, Foster CS. Multiple sclerosis-associated uveitis. *Ocul Immunol Inflamm*. 2004 Jun;12(2):137-42.
 - 66. Bonhomme GR, Waldman AT, Balcer LJ, et al. Pediatric optic neuritis: brain MRI abnormalities and risk of multiple sclerosis. *Neurology*. 2009;72(10):881-5. doi: 10.1212/01.wnl.0000344163.65326.48.
 - 67. Waldman AT, Stull LB, Galetta SL, et al. Pediatric optic neuritis and risk of multiple sclerosis: meta-analysis of observational studies. *J AAPOS*. 2011;15(5):441-6. doi: 10.1016/j.jaapos.2011.05.020.
 - 68. Wilejto M, Shroff M, Buncic JK, JR, Goia C, Banwell B. The clinical features, MRI findings, and outcome of optic neuritis in children. *Neurology*. 2006;67:258-62
 - 69. Jacobs LD, Beck RW, Simon JH, et al. Intramuscular interferon beta-1a therapy initiated during a first demyelinating event in multiple sclerosis. CHAMPS Study Group. *N Engl J Med*. 2000 Sep 28;343(13):898-904.
 - 70. Galetta SL, Markowitz C, Lee AG. Immunomodulatory agents for the treatment of relapsing multiple sclerosis: a systematic review. *Arch Intern Med*. 2002 Oct 28;162(19):2161-9.
 - 71. Arnold AC. Evolving management of optic neuritis and multiple sclerosis. *Am J Ophthalmol*. 2005;139(6):1101-8.
 - 72. Tanoğlu C. Multipl sklerozda yeni tedaviler. *Turkiye Klinikleri J Neurol – Special Topics* 2015;8(4):23-8
 - 73. Mandal P, Gupta A, Fusi-Rubiano W, et al. Fingolimod: therapeutic mechanisms and ocular adverse effects. *Eye (Lond)*. 2017;31(2):232–240. doi: 10.1038/eye.2016.258
 - 74. Nolan R, Gelfand JM, Green AJ. Fingolimod treatment in multiple sclerosis leads to increased macular volume. *Neurology*. 2013;80(2):139–44. doi: 10.1212/WNL.0b013e31827b9132
 - 75. Bennett JL. Finding NMO: The Evolving Diagnostic Criteria of Neuromyelitis Optica. *J Neuro-ophthalmol*. 2016;36(3):238-45.
 - 76. Devic E. Myelite subaigue compliquée de névrite optique. *Bull Med (Paris)* 1894;8:1033-4.
 - 77. Wingerchuk DM, Hogancamp WF, O'Brien PC, et al. The clinical course of neuromyelitis optica (Devic's syndrome) *Neurology*. 1999;53:1107–14. doi: 10.1212/WNL.53.5.1107.
 - 78. Lennon VA, Kryzer TJ, Pittock SJ, et al. IgG marker of optic-spinal multiple sclerosis binds to the aquaporin-4 water channel. *J Exp Med*. 2005;202(4):473-7 doi: 10.1084/jem.20050304
 - 79. Jacob A, McKeon A, Nakashima I, et al. Current concept of neuromyelitis optica (NMO) and NMO spectrum disorders. *J Neurol Neurosurg Psychiatry*. 2013;84(8):922-30. doi: 10.1136/jnnp-2012-302310
 - 80. Etemadifar M, Nasr Z, Khalili B, et al. Epidemiology of neuromyelitis optica in the world: a systematic review and meta-analysis. *Mult Scler Int*. 2015;2015:174720. doi: 10.1155/2015/174720.
 - 81. Quek AM, McKeon A, Lennon VA, et al. Effects of age and sex on aquaporin-4 autoimmunity. *Arch Neurol*. 2012;69(8):1039-43. doi: 10.1001/archneurol.2012.249.
 - 82. Tillema JM, McKeon A. The spectrum of neuromyelitis optica (NMO) in childhood. *J Child Neurol* 2012;27:1437-7.
 - 83. Matiello M, Kim HJ, Kim W, et al. Familial neuromyelitis optica. *Neurology*. 2010;75(4):310-5. doi: 10.1212/WNL.0b013e3181ea9f15.
 - 84. Wingerchuk DM, Lennon VA, Lucchinetti CF, et al. The spectrum of neuromyelitis optica. *Lancet Neurol* 2007; 6:805.
 - 85. Wingerchuk DM. Evidence for humoral autoimmunity in neuromyelitis optica. *Neurol Res* 2006; 28:348.

86. Lucchinetti CF, Mandler RN, McGavern D, et al. A role for humoral mechanisms in the pathogenesis of Devic's neuromyelitis optica. *Brain* 2002; 125:1450.
87. Correale J, Fiol M. Activation of humoral immunity and eosinophils in neuromyelitis optica. *Neurology* 2004; 63:2363.
88. Agre P. Aquaporin water channels (Nobel Lecture). *Angew Chem Int Ed Engl*. 2004;43(33):4278-90.
89. Newman EA. Propagation of intercellular calcium waves in retinal astrocytes and Müller cells. *J Neurosci*. 2001;21(7):2215-23
90. Pittock SJ, Weinshenker BG, Lucchinetti CF, et al. Neuromyelitis optica brain lesions localized at sites of high aquaporin 4 expression. *Arch Neurol*. 2006;63(7):964-8.
91. Bennett JL, Lam C, Kalluri SR, et al. Intrathecal pathogenic anti-aquaporin-4 antibodies in early neuromyelitis optica. *Ann Neurol* 2009; 66:617.
92. Papadopoulos MC, Verkman AS. Aquaporin 4 and neuromyelitis optica. *Lancet Neurol* 2012; 11:535.
93. Hinson SR, McKeon A, Lennon VA. Neurological autoimmunity targeting aquaporin-4. *Neuroscience* 2010; 168:1009.
94. Trandtranip L, Yao X, Su T, et al. Bystander mechanism for complement-initiated early oligodendrocyte injury in neuromyelitis optica. *Acta Neuropathol*. 2017;134(1):35–44 doi: 10.1007/s00401-017-1734-6
95. Jarius S, Ruprecht K, Wildemann B, et al. Contrasting disease patterns in seropositive and seronegative neuromyelitis optica: a multicentre study of 175 patients. *J Neuroinflammation*. 2012;9:14. doi: 10.1186/1742-2094-9-14.
96. Pittock SJ, Lennon VA, de Seze J, et al. Neuromyelitis optica and non organ-specific autoimmunity. *Arch Neurol*. 2008;65:78–83.
97. Furukawa Y, Yoshikawa H, Yachie A, et al. Neuromyelitis optica associated with myasthenia gravis: characteristic phenotype in Japanese population. *Eur J Neurol*. 2006;13:655–8.
98. Kister I, Gulati S, Boz C, et al. Neuromyelitis optica in patients with myasthenia gravis who underwent thymectomy. *Arch Neurol*. 2006;63:851–6.
99. Antoine JC, Camdessanché JP, Absi L, Lassabiére F, Féasson L. Devic disease and thymoma with anti-central nervous system and antithymus antibodies. *Neurology*. 2004;62:978–80.
100. Levin MH, Bennett JL, Verkman AS. Optic neuritis in neuromyelitis optica. *Prog Retin Eye Res*. 2013;36:159–71. doi: 10.1016/j.preteyeres.2013.03.001
101. Papais-Alvarenga RM, Carellos SC, Alvarenga MP, et al. Clinical course of optic neuritis in patients with relapsing neuromyelitis optica. *Arch Ophthalmol*. 2008;126(1):12-6. doi: 10.1001/archophthalmol.2007.26.
102. Wingerchuk DM, Banwell B, Bennett JL, et al. International consensus diagnostic criteria for neuromyelitis optica spectrum disorders. *Neurology* 2015;85(2):177-89 doi:10.1212/WNL.0000000000001729
103. Ramanathan S, Prelog K, Barnes EH, et al. Radiological differentiation of optic neuritis with myelin oligodendrocyte glycoprotein antibodies, aquaporin-4 antibodies, and multiple sclerosis. *Mult Scler* 2015;1 – 13 DOI: 10.1177/ 1352458515593406
104. Takahashi T, Fujihara K, Nakashima I, et al. Anti-aquaporin-4 antibody is involved in the pathogenesis of NMO: a study on antibody titre. *Brain* 2007; 130:1235.
105. Waters PJ, McKeon A, Leite MI, et al. Serologic diagnosis of NMO: a multicenter comparison of aquaporin-4-IgG assays. *Neurology* 2012;78:665.
106. Akman-Demir G, Tüzün E, Waters P, et al. Prognostic implications of aquaporin-4 antibody status in neuromyelitis optica patients. *Journal of Neurology* 2011;258(3):464-70.
107. Jarius S, Aboul-Enein F, Waters P, et al. Antibody to aquaporin-4 in the long-term course of neuromyelitis optica. *Brain*. 2008;131(Pt 11):3072-80. doi: 10.1093/brain/awn240.
108. Gelfand JM, Cree BA, Nolan R, et al. Microcystic inner nuclear layer abnormalities and neuromyelitis optica. *JAMA Neurol*. 2013;70(5):629-33. doi: 10.1001/jamaneurol.2013.1832.
109. Naismith RT, Tutlam NT, Xu J, et al. Optical coherence tomography differs in neuromyelitis

- optica compared with multiple sclerosis. *Neurology*. 2009;72(12):1077-82. doi: 10.1212/01.wnl.0000345042.53843.d5.
110. Ratchford JN, Quigg ME, Conger A, et al. Optical coherence tomography helps differentiate neuromyelitis optica and MS optic neuropathies. *Neurology*. 2009;73(4):302-8. doi: 10.1212/WNL.0b013e3181af78b8.
111. Wingerchuk DM, Lennon VA, Pittock SJ, et al. Revised diagnostic criteria for neuromyelitis optica. *Neurology*. 2006;66(10):1485-9.
112. Wingerchuk DM, Lennon VA, Lucchinetti CF, et al. The spectrum of neuromyelitis optica. *Lancet Neurol*. 2007;6(9):805-15.
113. Sellner J, Boggild M, Clanet M, et al. EFNS guidelines on diagnosis and management of neuromyelitis optica. *Eur J Neurol*. 2010;17(8):1019-32. doi: 10.1111/j.1468-1331.2010.03066.x
114. Mealy MA, Wingerchuk DM, Palace J, et al. Comparison of relapse and treatment failure rates among patients with neuromyelitis optica: multicenter study of treatment efficacy. *JAMA Neurol*. 2014;71(3):324-30. doi: 10.1001/jamaneurol.2013.5699.
115. Buc M. New biological agents in the treatment of multiple sclerosis. *Bratisl Lek Listy*. 2018;119(4):191-197. doi: 10.4149/BLL_2018_035.
116. Peng Cx, Li HY, Wang W, et al. Retinal segmented layers with strong aquaporin-4 expression suffered more injuries in neuromyelitis optica spectrum disorders compared with optic neuritis with aquaporin-4 antibody seronegativity detected by optical coherence tomography. *Br J Ophthalmol* 2017;101:1032-7. Doi: 10.1136/bjophthalmol-2016-309412
117. Jarius S, Ruprecht K, Kleiter I, et al. in cooperation with the Neuromyelitis Optica Study Group (NEMOS). MOG-IgG in NMO and related disorders: a multicenter study of 50 patients. Part 2: Epidemiology, clinical presentation, radiological and laboratory features, treatment responses, and long-term outcome. *J Neuroinflammation*. 2016;13(1):280.
118. Pache F, Zimmermann H, Mikolajczak J, et al. in cooperation with the Neuromyelitis Optica Study Group (NEMOS) MOG-IgG in NMO and related disorders: a multicenter study of 50 patients. Part 4: Afferent visual system damage after optic neuritis in MOG-IgG-seropositive versus AQP4-IgG-seropositive patients *J Neuroinflammation*. 2016;13:282. doi: 10.1186/s12974-016-0720-6
119. Taşdemir V, Kürtüncü M. Merkezi Sinir Sisteminde Miyelin Oligodendrosit Glikoprotein Otoimmünitesinin Klinik ve Prognostik Açıdan Değerlendirilmesi. *Turk J Neurol* 2018;24:350-351 DOI:10.4274/tn.81598
120. Lana-Peixoto MA, Talim N. Neuromyelitis Optica Spectrum Disorder and Anti-MOG Syndromes. *Biomedicines*. 2019;7(2):42. doi: 10.3390/biomedicines7020042
121. Kidd D, Burton B, Plant GT, et al. Chronic relapsing inflammatory optic neuropathy (CRION). *Brain*. 2003;126(2):276-84.
122. Petzold A, Plant GT. Diagnosis and classification of autoimmune optic neuropathy. *Autoimmun Rev*. 2014 Apr-May;13(4-5):539-45. doi: 10.1016/j.autrev.2014.01.009
123. Petzold A, Plant GT. Chronic relapsing inflammatory optic neuropathy: a systematic review of 122 cases reported. *J Neurol*. 2014 Jan;261(1):17-26. doi: 10.1007/s00415-013-6957-4.
124. Colpak AI, Kurne AT, Oguz KK, et al. White matter involvement beyond the optic nerves in CRION as assessed by diffusion tensor imaging. *Int J Neurosci*. 2015;125(1):10-7. doi: 10.3109/00207454.2014.896912.
125. Costello F. Inflammatory optic neuropathies. *Continuum (Minneapolis Minn)* 2014;20(4):816-37. doi: 10.1212/01.CON.0000453316.60013.52. Review.
126. Chalmoukou K, Alexopoulos H, Akrivou S, et al. Anti-MOG antibodies are frequently associated with steroid-sensitive recurrent optic neuritis. *Neurol Neuroimmunol Neuroinflamm*. 2015;2(4):e131. doi: 10.1212/NXI.0000000000000131.
127. Malik S, Furlan AJ, Sweeney PJ, et al. *J Clin Neuroophthalmol*. 1992 Sep; 12(3):137-41. Optic neuropathy: a rare paraneoplastic syndrome.
128. Cross SA, Salomao DR, Parisi JE, et al. Paraneoplastic autoimmune optic neuritis with retinitis defined by CRMP-5-IgG. *Ann Neurol*. 2003;54(1):38-50.

129. Annus Á, Bencsik K, Obál I, et al. Paraneoplastic neuromyelitis optica spectrum disorder: A case report and review of the literature. *J Clin Neurosci.* 2018;48:7-10. doi: 10.1016/j.jocn.2017.10.030.
130. Paul R, Ghosh AK, Sinha A, et al. Paraneoplastic optic neuritis as the first manifestation of periampullary carcinoma. *Int J Appl Basic Med Res.* 2015;5(1):73-5. doi: 10.4103/2229-516X.149255.
131. Gaier ED, Boudreault K, Rizzo JE, et al. Atypical optic neuritis. *Curr Neurol Neurosci Rep.* 2015;15(12):76. doi: 10.1007/s11910-015-0598-1.
132. Jabs DA, Johns CJ. Ocular involvement in chronic sarcoidosis. *Am J Ophthalmol.* 1986;15;102(3):297-301.
133. Okumus G, Musellim B, Cetinkaya E, et al. Extrapulmonary involvement in patients with sarcoidosis in Turkey. *Respirology.* 2011;16(3):446-50. doi: 10.1111/j.1440-1843.2010.01878.x.
134. Yu-Wai-Man P, Crompton DE, Graham JY, et al. Optic perineuritis as a rare initial presentation of sarcoidosis. *Clin Exp Ophthalmol.* 2007;35(7):682-4.
135. Ing EB, Garrity JA, Cross SA, et al. Sarcoid masquerading as optic nerve sheath meningioma. *Mayo Clin Proc.* 1997;72(1):38-43.
136. Phillips YL, Eggenberger ER. Neuro-ophthalmic sarcoidosis. *Curr Opin Ophthalmol.* 2010;21(6):423-9. doi: 10.1097/ICU.0b013e32833eae4d.
137. Kurne A, Isikay IC, Karlioguz K, et al. A clinically isolated syndrome: a challenging entity: multiple sclerosis or collagen tissue disorders: clues for differentiation. *J Neurol.* 2008;255(11):1625-35. doi: 10.1007/s00415-008-0882-y.
138. Zahid S, Iqbal M. Systemic Lupus Erythematosus Presenting as Optic Neuropathy: A Case Report. *2019;11(6):e4806.* doi: 10.7759/cureus.4806.
139. Moraitis E, Stathopoulos Y, Hong Y, et al. Aquaporin-4 IgG antibody-related disorders in patients with juvenile systemic lupus erythematosus. *Lupus.* 2019;28(10):1243-1249.
140. Zhou H, Xia P, Hu X. A case of neuromyelitis optica spectrum disorders complicated with systemic lupus erythematosus and thymoma 2018;25:47(1):71-4.
141. Tan P, Yu WY, Umapathi T, et al. Severe optic neuritis in a patient with combined neuromyelitis optica spectrum disease and primary Sjögren's syndrome: a case report. *J Med Case Rep.* 2012;6:401. doi: 10.1186/1752-1947-6-401.
142. Fortin E, Heller HM, Lyons J, et al. Bilateral optic neuritis from acute HIV infection. *Neurol Clin Pract.* 2019;9(3):e19-e21. doi: 10.1212/CPJ.00000000000000583.
143. Povaliaeva DA, Egorov VV, Smoliakova GP, et al. Herpesviral infection as an etiological factor of acute idiopathic optic neuritis. *Vestn Oftalmol.* 2019;135(2):4-11. doi: 10.17116/oftalma20191350214
144. Klein A, Fischer N, Goldstein M, et al. The great imitator on the rise: ocular and optic nerve manifestations in patients with newly diagnosed syphilis. *Acta Ophthalmol.* 2019;97(4):641-7. doi: 10.1111/aos.13963.
145. Venugopal NP. Atypical optic neuritis due to tuberculosis. *Indian J Ophthalmol.* 2015 Jul;63(7):623. doi: 10.4103/0301-4738.167110.
146. Aragao RE, Barreira IM, Lima LN, et al. Bilateral optic neuritis after dengue viral infection: case report. *Arq Bras Oftalmol.* 2010;73(2):175-8.
147. Rose GE. Papillitis, retinal neovascularisation and recurrent retinal vein occlusion in Toxoplasma retinochoroiditis: a case report with uncommon clinical signs. *Aust N Z J Ophthalmol.* 1991;19(2):155-7.
148. Auw-Haedrich C, Staubach F, Witschel H. Optic disk drusen. *Surv Ophthalmol.* 2002;47:515-32.
149. Kinori M, Moroz I, Zolf R, et al. Pseudopapilledema--optic disc drusen. *Harefuah* 2013;152(3):154-7, 183, 183
150. Purvin V. Optic perineuritis: clinical and radiographic features. *Arch Ophthalmol.* 2001;119:1299.