

## Bölüm 5

### MULTİPL SKLEROZDA RADYOLOJİK BULGULAR

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#### GİRİŞ

Enflamatuvar, demiyelinizan, nörodejeneratif ve kronik bir hastalık olan multipl skleroz (MS) santral sinir sisteminin (SSS) sık görülen bir hastalığıdır (1). Dünya çapında 2,5 milyondan fazla insanı etkileyen bir hastalık olan MS'in, yapılan epidemiyolojik çalışmalarda, Türkiye'deki prevalansı 1000 genç yetişkinde 0,4-1 arasında bulunmuştur (2). Hastalık sıklıkla 20-40 yaş arası genç erişkinlerde ortaya çıkar ve kadın cinsiyet erkek cinsiyetten yaklaşık olarak 3 kat daha fazla etkilenir (3).

MS etiyojisi günümüzde net olarak anlaşılamamış olsa da, hem çevresel hem de genetik faktörlerin neden olduğu immün mekanizmaların hastalığın oluşumuna sebep olduğu düşünülmektedir. Vitamin D eksikliği, sigara kullanımı, ebstein-barr virüsü (EBV) gibi çevresel etkenler hastalığın oluşumunu etkilemektedir.

Çocukluk döneminde EBV enfeksiyonu geçirenlerde, bu enfeksiyonu geçirmeyenlere oranla, MS gelişme riskinin 15 kat, yaşamın daha geç dönemlerinde EBV enfeksiyonu geçirenlerde ise MS gelişme riskinin 30 kat arttığı bildirilmiştir. Ayrıca İnsan lökosit antijeni / Human leukocyte antigen (HLA)-DRB1\*15 ve HLA-DRB1\*03 genlerinin kişide bulunması da genetik faktörler olarak hastalığın oluşumunda etkenler arasındadır (4,5).

Beyin ve spinal kordun beyaz cevherinde fokal demiyelinizan plakların birikimi hastalığın temel histopatolojik özelliğidir. Ayrıca aksonal ve nöronal hasar da hastalık sürecinde izlenebilir (6-9).

Klinik seyri değişkenlik gösterebilen bir hastalık olan MS'te, bu değişkenlik hastalığın progresyonunda, başlangıç yaşında ve şeklinde, atak şiddeti ve sıklığında görülmektedir (10).

MS hastalığında; ekstremitelerde güçsüzlük, diplopi, ataksi, dizartri, optik nörit, konsantrasyon-bellek bozuklukları gibi klinik bulgular sık görülür (11).

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## SONUÇ

MRG tekniği MS tanısında yardımcı bir yöntem olarak yaygın bir şekilde kullanılmaktadır. Özellikle son yıllarda MRG tekniğindeki önemli gelişmeler, klinik ve laboratuvar bulguları ile birlikte, MS gibi nörolojik hastalıkların tanı ve takiplerinde daha da kolaylık sağlamaktadır. MS hastalığı klinik seyir ve görüntüleme özellikleri açısından değişkenlik gösterebilmektedir. Bu nedenle, MS hastalığında bildirilen lezyon tutulum yerlerinin, morfolojilerinin, karakterizasyonlarının ve hastalık süreci boyunca değişimlerinin bilinmesi, hem tanı koymak hem de tedavi planının belirlenmesi açısından son derece önemlidir.

## KAYNAKLAR

1. Filippi M, Bar-Or A, Piehl F, et al. Multiple sclerosis. Nature reviews. Disease primers 2018 8;4(1):43. doi: 10.1038/s41572-018-0041-4.
2. Türk Börü U, Alp R, Sur H, et al. Prevalence of multiple sclerosis door-to-door survey in Maltepe, Istanbul, Turkey. Neuroepidemiology 2006;27(1):17-21. doi: 10.1159/000093895.
3. Koch-Henriksen N, Sørensen PS. The changing demographic pattern of multiple sclerosis epidemiology. The Lancet. Neurology 2010;9(5):520-532. doi: 10.1016/S1474-4422(10)70064-8.
4. Handunnetthi L, Ramagopalan SV, Ebers GC. Multiple sclerosis, vitamin D, and HLA-DRB1\*15. Neurology 2010;74(23):1905-1910. doi: 10.1212/WNL.0b013e3181e24124.
5. Ascherio A, Munger KL. Environmental risk factors for multiple sclerosis. Part II: Non-infectious factors. Annals of neurology 2007;61(6):504-513. doi: 10.1002/ana.21141.
6. Prins M, Schul E, Geurts J, et al. Pathological differences between white and grey matter multiple sclerosis lesions. Annals of the New York Academy of Sciences 2015;1351(1):99-113. doi: 10.1111/nyas.12841.
7. Hafler DA, Slavik JM, Anderson DE, et al. Multiple sclerosis. Immunological reviews 2005;204(1):208-231. doi: 10.1111/j.0105-2896.2005.00240.x.
8. Frischer JM, Weigand SD, Guo Y, et al. Clinical and pathological insights into the dynamic nature of the white matter multiple sclerosis plaque. Annals of neurology 2015;78(5):710-721. doi: 10.1002/ana.24497.
9. Lucchinetti C, Brück W, Parisi J, et al. Heterogeneity of multiple sclerosis lesions: implications for the pathogenesis of demyelination. Annals of neurology 2000;47(6):707-717. doi: 10.1002/1531-8249(200006)47:6<707::aid-ana3>3.0.co;2-q.
10. Portaccio E, Bellinva A, Fonderico M, et al. Progression is independent of relapse activity in early multiple sclerosis: a real-life cohort study. Brain 2022;145(8):2796-2805. doi: 10.1093/brain/awac111.
11. Ford H. Clinical presentation and diagnosis of multiple sclerosis. . Clinical medicine (London, England) 2020;20(4):380-383. doi: 10.7861/clinmed.2020-0292.
12. Thompson AJ, Banwell BL, Barkhof F, et al. Diagnosis of multiple sclerosis: 2017 revisions of the McDonald criteria. The Lancet. Neurology 2018;17(2):162-173. doi: 10.1016/S1474-4422(17)30470-2.
13. Miller DH, Albert PS, Barkhof F, et al. Guidelines for the use of magnetic resonance

- techniques in monitoring the treatment of multiple sclerosis. US National MS Society Task Force. *Annals of neurology* 1996;39(1):6-16. doi: 10.1002/ana.410390104.
14. Miller DH, Grossman RI, Reingold SC, et al. The role of magnetic resonance techniques in understanding and managing multiple sclerosis. *Brain* 1998;121(1):3-24. doi: 10.1093/brain/121.1.3.
  15. Solomon AJ, Bourdette DN, Cross AH, et al. The contemporary spectrum of multiple sclerosis misdiagnosis: A multicenter study. *Neurology* 2016;87(13):1393-1399. doi: 10.1212/WNL.0000000000003152.
  16. Morrissey SP, Miller DH, Kendall BE, et al. The significance of brain magnetic resonance imaging abnormalities at presentation with clinically isolated syndromes suggestive of multiple sclerosis. A 5-year follow-up study. *Brain* 1993;116(Pt 1):135-146. doi: 10.1093/brain/116.1.135.
  17. Horsfield MA. Using diffusion-weighted MRI in multicenter clinical trials for multiple sclerosis. *Journal of the neurological sciences* 2001;186(1):51-54. doi: 10.1016/s0022-510x(01)00492-0.
  18. Pretorius PM, Quaghebeur G. The role of MRI in the diagnosis of MS. *Clinical radiology* 2003;58(6):434-448. doi: 10.1016/s0009-9260(03)00089-8.
  19. Ge Y. Multiple sclerosis: the role of MR imaging. *AJNR. American journal of neuroradiology* 2006;27(6):1165-1176.
  20. Minagar A. Gray matter involvement in multiple sclerosis: a new window into pathogenesis. *Journal of neuroimaging* 2003;13(4):291-292.
  21. Paolillo A, Giugni E, Bozzao A, et al. Sequenze FSE e fast-FLAIR nella sclerosi multipla [Fast spin echo and fast fluid attenuated inversion recovery sequences in multiple sclerosis]. *La Radiologia medica* 1997;93(6):686-691.
  22. Noseworthy JH, Lucchinetti C, Rodriguez M, et al. Multiple sclerosis. *The New England journal of medicine* 2000;343(13):938-952. doi: 10.1056/NEJM200009283431307.
  23. Trip SA, Miller DH. Imaging in multiple sclerosis. *Journal of neurology, neurosurgery, and psychiatry* 2005;76(3):iii11-iii18. doi: 10.1136/jnnp.2005.073213
  24. Miller DH, Barkhof F, Frank JA, et al. Measurement of atrophy in multiple sclerosis: pathological basis, methodological aspects and clinical relevance. *Brain* 2002;125(8):1676-1695. doi: 10.1093/brain/awf177.
  25. Dietemann JL, Beigelman C, Rumbach L, et al. Multiple sclerosis and corpus callosum atrophy: relationship of MRI findings to clinical data. *Neuroradiology* 1988;30(6):478-480. doi: 10.1007/BF00339686.
  26. Ge Y, Grossman RI, Udupa JK, et al. Brain atrophy in relapsing-remitting multiple sclerosis: fractional volumetric analysis of gray matter and white matter. *Radiology* 2001;220(3):606-610. doi: 10.1148/radiol.2203001776.
  27. Xu J, Kobayashi S, Yamaguchi S, et al. Gender effects on age-related changes in brain structure. *AJNR. American journal of neuroradiology* 2000;21(1):112-118.
  28. Ge Y, Grossman RI, Udupa JK, et al. Brain atrophy in relapsing-remitting multiple sclerosis and secondary progressive multiple sclerosis: longitudinal quantitative analysis. *Radiology* 2000;214(3):665-670. doi: 10.1148/radiology.214.3.r00mr30665.
  29. Fox NC, Jenkins R, Leary SM, et al. Progressive cerebral atrophy in MS: a serial study using registered, volumetric MRI. *Neurology* 2000;54(4):807-812. doi: 10.1212/wnl.54.4.807.

30. Kalkers NF, Ameziane N, Bot JC, et al. Longitudinal brain volume measurement in multiple sclerosis: rate of brain atrophy is independent of the disease subtype. *Archives of neurology* 2002;59(10):1572-1576. doi: 10.1001/archneur.59.10.1572.
31. Ge Y, Grossman RI, Babb JS, et al. Age-related total gray matter and white matter changes in normal adult brain. Part I: volumetric MR imaging analysis. *AJNR. American journal of neuroradiology* 2002;23(8):1327-1333.
32. Ikuta F, Zimmerman HM. Distribution of plaques in seventy autopsy cases of multiple sclerosis in the United States. *Neurology* 1976;26(6):26-28. doi: 10.1212/wnl.26.6\_part\_2.26.
33. Tartaglino LM, Friedman DP, Flanders AE, et al. Multiple sclerosis in the spinal cord: MR appearance and correlation with clinical parameters. *Radiology* 1995;195(3):725-732. doi: 10.1148/radiology.195.3.7754002.
34. Lycklama G, Thompson A, Filippi M, et al. Spinal-cord MRI in multiple sclerosis. *The Lancet. Neurology* 2003;2(9):555-562. doi: 10.1016/s1474-4422(03)00504-0.
35. Bot JC, Barkhof F, Polman CH, et al. Spinal cord abnormalities in recently diagnosed MS patients: added value of spinal MRI examination. *Neurology* 2004;62(2):226-233. doi: 10.1212/wnl.62.2.226.
36. Kearney H, Miller DH, Ciccarelli O. Spinal cord MRI in multiple sclerosis--diagnostic, prognostic and clinical value. *Nature reviews. Neurology* 2015;11(6):327-338. doi: 10.1038/nrneurol.2015.80.
37. Brownlee WJ, Altmann DR, Alves Da Mota P, et al. Association of asymptomatic spinal cord lesions and atrophy with disability 5 years after a clinically isolated syndrome. *Multiple sclerosis* 2017;23(5):665-674. doi: 10.1177/1352458516663034.
38. Arrambide G, Rovira A, Sastre-Garriga J, et al. Spinal cord lesions: A modest contributor to diagnosis in clinically isolated syndromes but a relevant prognostic factor. *Multiple sclerosis* 2018;24(3):301-312. doi: 10.1177/1352458517697830.
39. Muccilli A, Seyman E, Oh J. Spinal Cord MRI in Multiple Sclerosis. *Neurologic clinics* 2018;36(1):35-57. doi: 10.1016/j.ncl.2017.08.009.
40. Losseff NA, Webb SL, O'Riordan JI, et al. Spinal cord atrophy and disability in multiple sclerosis. A new reproducible and sensitive MRI method with potential to monitor disease progression. *Brain* 1996;119(3):701-708. doi: 10.1093/brain/119.3.701.
41. Nijeholt GJ, van Walderveen MA, Castelijns JA, et al. Brain and spinal cord abnormalities in multiple sclerosis. Correlation between MRI parameters, clinical subtypes and symptoms. *Brain* 1998;121(4):687-697. doi: 10.1093/brain/121.4.687.
42. Zivadinov R, Bakshi R. Role of MRI in multiple sclerosis II: brain and spinal cord atrophy. *Frontiers in bioscience* 2004;9(1):647-664. doi: 10.2741/1262.
43. Sandberg-Wollheim M, Bynke H, Cronqvist S, et al. A long-term prospective study of optic neuritis: evaluation of risk factors. *Annals of neurology* 1990;27(4):386-393. doi: 10.1002/ana.410270406.
44. Jin YP, de Pedro-Cuesta J, Huang YH, et al. Predicting multiple sclerosis at optic neuritis onset. *Multiple sclerosis* 2003;9(2):135-141. doi: 10.1191/1352458503ms895oa.
45. Hickman SJ. Optic nerve imaging in multiple sclerosis. *Journal of neuroimaging* 2007;17(1):42S-45S. doi: 10.1111/j.1552-6569.2007.00136.x.
46. Onofrij M, Tartaro A, Thomas A, et al. Long echo time STIR sequence MRI of optic nerves in optic neuritis. *Neuroradiology* 1996;38(1):66-69. doi: 10.1007/BF00593226.

47. Glisson CC, Galetta SL. Nonconventional optic nerve imaging in multiple sclerosis. *Neuroimaging clinics of North America* 2009;19(1):71-79. doi: 10.1016/j.nic.2008.09.003.
48. Filippi M, Rocca MA. MRI aspects of the “inflammatory phase” of multiple sclerosis. *Neurological sciences* 2003;24(5):275-278. doi: 10.1007/s10072-003-0173-4.
49. Filippi M, Tortorella C, Rovaris M. Magnetic resonance imaging of multiple sclerosis. *Journal of neuroimaging* 2002;12(4):289-301. doi: 10.1111/j.1552-6569.2002.tb00136.x.
50. Zivadinov R, Bakshi R. Role of MRI in multiple sclerosis I: inflammation and lesions. *Frontiers in bioscience* 2004;9(1):665-683. doi: 10.2741/1251.
51. Sahraian MA, Eshaghi A. Role of MRI in diagnosis and treatment of multiple sclerosis. *Clinical neurology and neurosurgery* 2010;112(7):609-615. doi: 10.1016/j.clin-neuro.2010.03.022.
52. Horowitz AL, Kaplan RD, Grewe G, et al. The ovoid lesion: a new MR observation in patients with multiple sclerosis. *AJNR. American journal of neuroradiology* 1989;10(2):303-305.
53. Nusbaum AO, Lu D, Tang CY, et al. Quantitative diffusion measurements in focal multiple sclerosis lesions: correlations with appearance on T1-weighted MR images. *AJR. American journal of roentgenology* 2000;175(3):821-825. doi: 10.2214/ajr.175.3.1750821.
54. Symms M, Jäger HR, Schmierer K, et al. A review of structural magnetic resonance neuroimaging. *Journal of neurology, neurosurgery, and psychiatry* 2004;75(9):1235-1244. doi: 10.1136/jnnp.2003.032714.
55. Miller D, Barkhof F, Montalban X, et al. Clinically isolated syndromes suggestive of multiple sclerosis, part 2: non-conventional MRI, recovery processes, and management. *The Lancet. Neurology* 2005;4(6):341-348. doi: 10.1016/S1474-4422(05)70095-8.
56. Hashemi RH, Bradley WG Jr, Chen DY, et al. Suspected multiple sclerosis: MR imaging with a thin-section fast FLAIR pulse sequence. *Radiology* 1995;196(2):505-510. doi: 10.1148/radiology.196.2.7617868.
57. Yousry TA, Filippi M, Becker C, et al. Comparison of MR pulse sequences in the detection of multiple sclerosis lesions. *AJNR. American journal of neuroradiology* 1997;18(5):959-963.
58. Dohi N, Ishikawa S, Kamijyo Y, et al. Multiple sclerosis with open-ring enhancement in the cerebrum and spinal cord. *Internal medicine* 2003;42(3):273-276. doi: 10.2169/internalmedicine.42.273.
59. Napoli SQ, Bakshi R. Magnetic resonance imaging in multiple sclerosis. *Reviews in neurological diseases* 2005;2(3):109-116.
60. Schafer J, Srinivasan A, Mukherji S. Diffusion magnetic resonance imaging in the head and neck. *Magnetic resonance imaging clinics of North America* 2011 ;19(1):55-67. doi: 10.1016/j.mric.2010.10.002.
61. Goveas J, O'Dwyer L, Mascalchi M, et al. Diffusion-MRI in neurodegenerative disorders. *Magnetic resonance imaging* 2015;33(7):853-876. doi: 10.1016/j.mri.2015.04.006.
62. Sheerin F, Pretorius PM, Briley D, et al. Differential diagnosis of restricted diffusion confined to the cerebral cortex. *Clinical radiology* 2008;63(11):1245-1253. doi: 10.1016/j.crad.2007.12.018.

63. Bakshi R, Thompson AJ, Rocca MA, et al. MRI in multiple sclerosis: current status and future prospects. *The Lancet. Neurology* 2008;7(7):615-625. doi: 10.1016/S1474-4422(08)70137-6.
64. Ernst T, Chang L, Walot I, et al. Physiologic MRI of a tumefactive multiple sclerosis lesion. *Neurology* 1998;51(5):1486-1488. doi: 10.1212/wnl.51.5.1486.
65. Horsfield MA, Lai M, Webb SL, et al. Apparent diffusion coefficients in benign and secondary progressive multiple sclerosis by nuclear magnetic resonance. *Magnetic resonance in medicine* 1996;36(3):393-400. doi: 10.1002/mrm.1910360310.
66. Horsfield MA, Larsson HB, Jones DK, et al. Diffusion magnetic resonance imaging in multiple sclerosis. *Journal of neurology, neurosurgery, and psychiatry* 1998;64(1):80-84.
67. Werring DJ, Clark CA, Droogan AG, et al. Water diffusion is elevated in widespread regions of normal-appearing white matter in multiple sclerosis and correlates with diffusion in focal lesions. *Multiple sclerosis* 2001;7(2):83-89. doi: 10.1177/135245850100700202.
68. Mahmood U, Koutcher JA. Magnetic resonance spectroscopy and imaging in radiology. *Medical physics* 1995;22(11):1935-1941. doi: 10.1118/1.597643.
69. Cousins JP. Clinical MR spectroscopy: fundamentals, current applications, and future potential. *AJR. American journal of roentgenology* 1995;164(6):1337-1347. doi: 10.2214/ajr.164.6.7754871.
70. Tran T, Ross B, Lin A. Magnetic resonance spectroscopy in neurological diagnosis. *Neurologic clinics* 2009;27(1):21-60, xiii. doi: 10.1016/j.ncl.2008.09.007.
71. Currie S, Hadjivassiliou M, Craven IJ, et al. Magnetic resonance spectroscopy of the brain. *Postgraduate medical journal* 2013;89(1048):94-106. doi: 10.1136/postgradmedj-2011-130471.
72. Arnold DL, Matthews PM, Francis G, et al. Proton magnetic resonance spectroscopy of human brain in vivo in the evaluation of multiple sclerosis: assessment of the load of disease. *Magnetic resonance in medicine* 1990;14(1):154-159. doi: 10.1002/mrm.1910140115.
73. De Stefano N, Narayanan S, Francis GS, et al. Evidence of axonal damage in the early stages of multiple sclerosis and its relevance to disability. *Archives of neurology* 2001; 58(1):65-70. doi: 10.1001/archneur.58.1.65.