



Bölüm 5

Spinal Kord Tümörleri

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Epidemiyoloji-Etiyoloji

Primer spinal kord bölge tümörleri, tüm merkezi sinir sistemi tümörlerinin yaklaşık %3'ünü oluşturmaktadır. Bu bölge tümörleri Dünya Sağlık Örgütü (DSÖ)'üne göre histolojik olarak evrendirilirken, aynı zamanda spinal korddaki yerleşim yerine göre de ekstradural, intradural-ekstra medüller ve intradural-intramedüller olmak üzere sınıflandırılabilir.

Primer spinal bölge tümörlerinin %50-55'i torasik bölgede, % 25-30'u ise lumbosakral bölgede yerleşmektedir (1). Schwannomalar en sık torasik bölgede yerleşirken intervertebral foramen bölgesinde "dumbbell" görünümü tipiktir. Menenjiomlar sıklıkla foramen magnum düzeyinde, ependimomlar sıklıkla konus medülleris ve kauda ekina düzeyinde yerleşmektedir. Astrositomlar ise tüm spinal bölgede görülebilmektedir. Kordomalar ise genellikle sakral bölgede yerleşmekle birlikte nadiren servikal bölgede de izlenebilmektedir.

SEER (2004-2007) verilerine göre primer spinal tümörlerin %22'si malign, %78 benignidir.

En sık tümör yerleşimi kord bölgesinde (%60) iken, ardından meninks (%36) ve kauda ekuina (%4) gelmektedir. İnsidans yaşla birlikte artış gösterirken 7. Dekatta pik yapmaktadır. Malign tümörler açısından cinsiyet farkı gözlenmezken, benign tümörlerde kadınlarda (%60) daha sık gözlenmektedir.

Erişkinlerde en sık gözlenen histolojik tipler; menenjiom (%37,6), sinir kılıfı tümörleri (%23,1), ependimom (%20,5) ve astrositom (%4,2) iken, çocuklarda en sık astrositoma (%31,4), ependimoma (%21,6), oligodendroglioma (%16,8), periferik sinir kılıfı tümörleri (%13,3) ve menenjiomlar (%7,4) izlenmektedir.

Uzun süre önce (yaklaşık 20 yıl) maruz kalınan radyasyon öyküsüne bağlı sarkomlar, gliomlar görülebilmektedir. Ayrıca NF tip 1, NF tip 2, Von Hippel Lindau gibi sendromlar ile birlikte olabilir. NF tip 1 sendromlu vakalarda yapılan taramalarda %40 oranında spinal bölgede tümör saptanmakta ve %2'sinde nörolojik semptomlar görülmüştür (2). Ancak NF tip 2 olan vakalarda %60-80 spinal tümör görülebilenken, sıklıkla cerrahi rezeksiyona ihtiyaç duyul-

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daha yüksek olabileceğini bildirmişlerdir (69).

Hem hayvan hem de insan çalışmaları, ışınlanmış omuriliğin zaman içinde en azından kısmen iyileşebileceğini göstermiştir. Rhesus maymunlarının kullanıldığı hayvan deneylerinde kordun tamir olasılığı 1, 2 ve 3 yılda %76, %85 ve %100 olarak tahmin edilmiştir (93-95). Yeniden ışınlamanın ilk radyasyon tedavisinden en az 6 ay sonra olduğu insan çalışmalarında, esasen kümülatif 2-Gy eşdeğer dozların 60 Gy veya daha az olduğu hastalarda miyelopati görülmemiştir (89,96).

Sonuç

Spinal kanal tümörleri nispeten nadirdir ve çeşitli histolojik tanılara göre yaklaşımları değişiklik göstermektedir. Nöroşirürji tekniklerindeki kademeli ilerlemelerin yardımıyla cerrahi, birincil tedavi yöntemi olmaya devam etmektedir. Adjuvan RT genellikle tam olmayan rezeksiyon, yineleyen tümörler veya yüksek dereceli tümörler için ön planda yer almaktadır. YART veya SRS gibi yeni RT teknikleri, terapötik oranı iyileştirmek için umut verici bir potansiyel göstermiştir. Klinik sonuçların uzun vadeli takibi tedavi yönetimini iyileştirmek için önemlidir.

Kaynaklar

1. Ostrom QT, Gittleman H, Farah P, et al. CBTRUS statistical report: primary brain and central nervous system tumors diagnosed in the United States in 2006-2010. *Neuro Oncol.* 2013;2:ii1–ii56.
2. Thakkar SD, Feigen U, Mautner VF. Spinal tumours in neurofibromatosis type 1: an MRI study of frequency, multiplicity and variety. *Neuroradiology.* 1999;41:625–629.
3. Evans DG, Raymond FL, Barwell JG, et al. Genetic testing and screening of individuals at risk of NF2. *Clin Genet.* 2012;82:416–424.
4. Raco A, Esposito V, Lenzi J, et al. Long-term follow-up of intramedullary spinal cord tumors: a series of 202 cases. *Neurosurgery* 2005;56(5):972–981; discussion 972–981.
5. Bannister R. Disorders of the spinal cord. In: Brain W, Bannister R, eds. *Clinical neurology.* London, UK: Oxford University Press, 1998.
6. DeSousa AL, Kalsbeck JE, Mealey J Jr, et al. Intraspinal tumors in children. A review of 81 cases. *J Neurosurg* 1979;51(4):437–445.
7. Reimer R, Onofrio BM. Astrocytomas of the spinal cord in children and adolescents. *J Neurosurg* 1985;63(5):669–675.
8. Uhl M, Sterzing F, Habl G, et al. CT-myelography for high-dose irradiation of spinal and paraspinal tumors with helical tomotherapy: revival of an old tool. *Strahlenther Onkol* 2011;187(7):416–420.
9. Gado M, Sartor K, Hodges F. The spine. In: Lee J, Sengel S, Stanley R, eds. *Computed body tomography.* New York: Raven Press, 1989.
10. Sze G. Neoplastic disease of the spine and spinal cord. In: Atlas SW, ed. *Magnetic resonance imaging of the brain and spine.* Philadelphia: Lippincott-Raven, 1996.
11. Perry A, Miller CR, Gujrati M, et al. Malignant gliomas with primitive neuroectodermal tumor-like components: a clinicopathologic and genetic study of 53 cases. *Brain Pathol* 2009;19(1):81–90.
12. Rodriguez FJ, Perry A, Rosenblum MK, et al. Disseminated oligodendroglial-like leptomeningeal tumor of childhood: a distinctive clinicopathologic entity. *Acta Neuropathol* 2012;124(5):627–641.
13. Louis DN, Ohgaki H, Wiestler OD, et al. The 2007 WHO classification of tumours of the central nervous system. *Acta Neuropathol* 2007;114(2):97–109.
14. Louis DN, Perry A, Reifenberger G, et al. The 2016 World Health Organization Classification of Tumors of the Central Nervous System: a summary. *Acta Neuropathol* 2016;131(6):803–820.
15. Grimm S, Chamberlain MC. Adult primary spinal cord tumors. *Expert Rev Neurother* 2009;9(10):1487–1495.
16. Celano E, Salehani A, Malcolm JG, et al. Spinal cord ependymoma: a review of the literature and case series of ten patients. *J Neurooncol* 2016;128(3):377–386.
17. Abdel-Wahab M, Etuk B, Palermo J, et al. Spinal cord gliomas: a multi-institutional retrospective analysis. *Int J Radiat Oncol Biol Phys* 2006;64(4):1060–1071.
18. Epstein FJ, Farmer JP, Freed D. Adult intramedullary astrocytomas of the spinal cord. *J Neurosurg*

- 1992;77(3):355–359.
19. Rossitch E Jr, Zeidman SM, Burger PC, et al. Clinical and pathological analysis of spinal cord astrocytomas in children. *Neurosurgery* 1990;27(2):193–196
 20. Samii M, Klekamp J. Surgical results of 100 intramedullary tumors in relation to accompanying syringomyelia. *Neurosurgery* 1994;35(5):865–873; discussion 873.
 21. Henson JW. Spinal cord gliomas. *Curr Opin Neurol* 2001;14(6):679–682.
 22. Lonser RR, Weil RJ, Wanebo JE, et al. Surgical management of spinal cord hemangioblastomas in patients with von Hippel-Lindau disease. *J Neurosurg* 2003;98(1):106–116.
 23. Ryu SI, Kim DH, Chang SD. Stereotactic radiosurgery for hemangiomas and ependymomas of the spinal cord. *Neurosurg Focus* 2003;15(5):E10.
 24. Setzer M, Vatter H, Marquardt G, et al. Management of spinal meningiomas: surgical results and a review of the literature. *Neurosurg Focus* 2007;23(4):E14.
 25. Carroll SL. The challenge of cancer genomics in rare nervous system neoplasms: malignant peripheral nerve sheath tumors as a paradigm for cross-species comparative oncogenomics. *Am J Pathol* 2016;186(3):464–477.
 26. Evans DG, Birch JM, Ramsden RT, et al. Malignant transformation and new primary tumours after therapeutic radiation for benign disease: substantial risks in certain tumour prone syndromes. *J Med Genet* 2006;43(4):289–294.
 27. Grobmyer SR, Reith JD, Shahlaee A, et al. Malignant Peripheral Nerve Sheath Tumor: molecular pathogenesis and current management considerations. *J Surg Oncol* 2008;97(4):340–349.
 28. James AW, Shurell E, Singh A, et al. Malignant peripheral nerve sheath tumor. *Surg Oncol Clin N Am* 2016;25(4):789–802.
 29. Shirato H, Kamada T, Hida K, et al. The role of radiotherapy in the management of spinal cord glioma. *Int J Radiat Oncol Biol Phys*. 1995;33:323–328.
 30. Xu QW, Bao WM, Mao RL, et al. Aggressive surgery for intramedullary tumor of cervical spinal cord. *Surg Neurol*. 1996;46:322–328.
 31. Kim MS, Chung CK, Choe G, et al. Intramedullary spinal cord astrocytoma in adults: postoperative outcome. *J Neurooncol*. 2001;52:85–94.
 32. Guidetti B, Mercuri S, Vagnozzi R. Long-term results of the surgical treatment of 129 intramedullary spinal gliomas. *J Neurosurg* 1981;54(3):323–330.
 33. Chan HS, Becker LE, Hoffman HJ, et al. Myxopapillary ependymoma of the filum terminale and cauda equina in childhood: report of seven cases and review of the literature. *Neurosurgery* 1984;14(2):204–210.
 34. Sonneland PR, Scheithauer BW, Onofrio BM. Myxopapillary ependymoma. A clinicopathologic and immunocytochemical study of 77 cases. *Cancer* 1985;56(4):883–893.
 35. Fassett DR, Pingree J, Kestle JR. The high incidence of tumor dissemination in myxopapillary ependymoma in pediatric patients. Report of five cases and review of the literature. *J Neurosurg* 2005;102(1 Suppl):59–64.
 36. Shaw EG, Evans RG, Scheithauer BW, et al. Radiotherapeutic management of adult intraspinal ependymomas. *Int J Radiat Oncol Biol Phys* 1986;12(3):323–327.
 37. Garces-Ambrossi GL, McGirt MJ, Mehta VA, et al. Factors associated with progression-free survival and long-term neurological outcome after resection of intramedullary spinal cord tumors: analysis of 101 consecutive cases. *J Neurosurg Spine* 2009;11(5):591–599.
 38. McGirt MJ, Chaichana KL, Atiba A, et al. Resection of intramedullary spinal cord tumors in children: assessment of long-term motor and sensory deficits. *J Neurosurg Pediatr* 2008;1(1):63–67.
 39. Matsuyama Y, Sakai Y, Katayama Y, et al. Surgical results of intramedullary spinal cord tumor with spinal cord monitoring to guide extent of resection. *J Neurosurg Spine* 2009;10(5):404–413.
 40. Jallo GI, Freed D, Epstein F. Intramedullary spinal cord tumors in children. *Childs Nerv Syst*. 2003;19:641–649.
 41. Kothbauer KF, Deletis V, Epstein FJ. Motor-evoked potential monitoring for intramedullary spinal cord tumor surgery: correlation of clinical and neurophysiological data in a series of 100 consecutive procedures. *Neurosurg Focus* 1998;4(5):e1.
 42. Brotchi J, Fischer G. Spinal cord ependymomas. *Neurosurg Focus* 1998;4(5):e2.
 43. Cooper PR. Outcome after operative treatment of intramedullary spinal cord tumors in adults: intermediate and long-term results in 51 patients. *Neurosurgery* 1989;25(6):855–859.
 44. Epstein FJ, Farmer JP, Freed D. Adult intramedullary spinal cord ependymomas: the result of surgery in 38 patients. *J Neurosurg* 1993;79(2):204–209.

45. Mattei TA, Teles AR, Mendel E. Modern surgical techniques for management of soft tissue sarcomas involving the spine: outcomes and complications. *J Surg Oncol* 2015;111(5):580–586.
46. Nakamura M, Tsuji O, Fujiyoshi K, et al. Long-term surgical outcomes of spinal meningiomas. *Spine* 2012;37(10):E617–E623.
47. Brandes AA, Cavallo G, Reni M, et al. A multicenter retrospective study of chemotherapy for recurrent intracranial ependymal tumors in adults by the Gruppo Italiano Cooperativo di Neuro-Oncologia. *Cancer* 2005;104(1):143–148.
48. Gornet MK, Buckner JC, Marks RS, et al. Chemotherapy for advanced CNS ependymoma. *J Neurooncol* 1999;45(1):61–67.
49. Chamberlain MC. Temozolomide for recurrent low-grade spinal cord gliomas in adults. *Cancer* 2008;113(5):1019–1024.
50. Doireau V, Grill J, Zerah M, et al. Chemotherapy for unresectable and recurrent intramedullary glial tumours in children. *Brain Tumours Subcommittee of the French Society of Paediatric Oncology (SFOP). Br J Cancer* 1999;81(5):835–840.
51. Allen JC, Aviner S, Yates AJ, et al. Treatment of high-grade spinal cord astrocytoma of childhood with “8-in-1” chemotherapy and radiotherapy: a pilot study of CCG-945. *Children’s Cancer Group. J Neurosurg* 1998;88(2):215–220.
52. Jakacki RI, Cohen KJ, Buxton A, et al. Phase 2 study of concurrent radiotherapy and temozolomide followed by temozolomide and lomustine in the treatment of children with high-grade glioma: a report of the Children’s Oncology Group ACNS0423 study. *Neuro Oncol* 2016;18(10):1442–1450.
53. Constantini S, Miller DC, Allen JC, et al. Radical excision of intramedullary spinal cord tumors: surgical morbidity and long-term follow-up evaluation in 164 children and young adults. *J Neurosurg* 2000;93:183–193.
54. Eroes CA, Zausinger S, Kreth FW, et al. Intramedullary low grade astrocytoma and ependymoma. Surgical results and predicting factors for clinical outcome. *Acta Neurochir (Wein)* 2010;152(4):611–618.
55. Yang S, Yang X, Hong G. Surgical treatment of one hundred seventy-four intramedullary spinal cord tumors. *Spine* 2009;34(24):2705–2710.
56. Guidetti B, Mercuri S, Vagnozzi R. Long-term results of the surgical treatment of 129 intramedullary spinal gliomas. *J Neurosurg* 1981;54(3):323–330.
57. Pica A, Miller R, Villa S, et al. The results of surgery, with or without radiotherapy, for primary spinal myxopapillary ependymoma: a retrospective study from the Rare Cancer Network. *Int J Radiat Oncol Biol Phys* 2009;74:1114–1120.
58. Isaacson SR. Radiation therapy and the management of intramedullary spinal cord tumors. *J Neurooncol* 2000;47(3):231–238.
59. Mayfield JK. Postradiation spinal deformity. *Orthop Clin North Am* 1979;10(4):829–844.
60. Kim MS, Chung CK, Choe G, et al. Intramedullary spinal cord astrocytoma in adults: postoperative outcome. *J Neurooncol* 2001;52(1):85–94.
61. Gomez DR, Missett BT, Wara WM, et al. High failure rate in spinal ependymomas with long-term follow-up. *Neuro Oncol* 2005;7(3):254–259.
62. Chao ST, Kobayashi T, Benzel E, et al. The role of adjuvant radiation therapy in the treatment of spinal myxopapillary ependymomas. *J Neurosurg Spine* 2011;14(1):59–64.
63. Mirimanoff RO, Dosoretz DE, Linggood RM, et al. Meningioma: analysis of recurrence and progression following neurosurgical resection. *J Neurosurg* 1985;62(1):18–24.
64. Gerszten PC, Burton SA, Ozhasoglu C, et al. Radio-surgery for benign intradural spinal tumors. *Neurosurgery* 2008;62(4):887–895; discussion 895–886.
65. Gezen F, Kahraman S, Canakci Z, et al. Review of 36 cases of spinal cord meningioma. *Spine* 2000;25(6):727–731.
66. Merchant TE, Kiehna EN, Thompson SJ, et al. Pediatric low-grade and ependymal spinal cord tumors. *Pediatr Neurosurg* 2000;32(1):30–36.
67. Hall EJ, Wu CS. Radiation-induced second cancers: the impact of 3D-CRT and IMRT. *Int J Radiat Oncol Biol Phys* 2003;56(1):83–88.
68. Hsu W, Nguyen T, Kleinberg L, et al. Stereotactic radiosurgery for spine tumors: review of current literature. *Stereotact Funct Neurosurg* 2010;88(5):315–321.
69. Daly ME, Choi CY, Gibbs IC, et al. Tolerance of the spinal cord to stereotactic radiosurgery: insights from hemangioblastomas. *Int J Radiat Oncol Biol Phys* 2011;80(1):213–220.
70. Mohan R, Grosshans D. Proton therapy—Present and future. *Adv Drug Deliv Rev* 2017;109:26–44.
71. Merchant TE. Proton beam therapy in pediatric oncology. *Cancer J* 2009;15(4):298–305.

72. Travis LB, Fossa SD, Schonfeld SJ, et al. Second cancers among 40,576 testicular cancer patients: focus on long-term survivors. *J Natl Cancer Inst* 2005;97(18):1354–1365.
73. Tukenova M, Guibout C, Oberlin O, et al. Role of cancer treatment in longterm overall and cardiovascular mortality after childhood cancer. *J Clin Oncol* 2010;28(8):1308–1315.
74. Amsbaugh MJ, Grosshans DR, McAleer MF, et al. Proton therapy for spinal ependymomas: planning, acute toxicities, and preliminary outcomes. *Int J Radiat Oncol Biol Phys* 2012;83(5):1419–1424.
75. Garcia DM. Primary spinal cord tumors treated with surgery and postoperative irradiation. *Int J Radiat Oncol Biol Phys* 1985;11(11):1933–1939.
76. Linstadt DE, Wara WM, Leibel SA, et al. Postoperative radiotherapy of primary spinal cord tumors. *Int J Radiat Oncol Biol Phys* 1989;16(6):1397–1403.
77. Kopelson G, Linggood RM. Intramedullary spinal cord astrocytoma versus glioblastoma: the prognostic importance of histologic grade. *Cancer* 1982;50(4):732–735.
78. Abdel-Wahab M, Corn B, Wolfson A, et al. Prognostic factors and survival in patients with spinal cord gliomas after radiation therapy. *Am J Clin Oncol* 1999;22(4):344–351.
79. Landberg T, Chavaudra J, Dobbs J, et al. Report 50. *J ICRU*. 1993;os26:NP.
80. Morgan-Fletcher SL. Prescribing, recording and reporting photon beam therapy (supplement to ICRU report 50), ICRU report 62. ICRU, pp. ix+52, 1999 (ICRU, Bethesda, MD). 2001
81. Merchant TE, Nguyen D, Thompson SJ, et al. High-grade pediatric spinal cord tumors. *Pediatr Neurosurg* 1999;30(1):1–5.
82. Wen BC, Hussey DH, Hitchon PW, et al. The role of radiation therapy in the management of ependymomas of the spinal cord. *Int J Radiat Oncol Biol Phys* 1991;20(4):781–786.
83. Whitaker SJ, Bessell EM, Ashley SE, et al. Postoperative radiotherapy in the management of spinal cord ependymoma. *J Neurosurg* 1991;74(5):720–728.
84. Fein DA, Marcus RB Jr, Parsons JT, et al. Lhermitte's sign: incidence and treatment variables influencing risk after irradiation of the cervical spinal cord. *Int J Radiat Oncol Biol Phys* 1993;27(5):1029–1033.
85. Jones A. Transient radiation myelopathy (with Reference to Lhermitte's Sign of Electrical Paraesthesia). *Br J Radiol* 1964;37:727–744.
86. Schultheiss TE, Higgins EM, El-Mahdi AM. The latent period in clinical radiation myelopathy. *Int J Radiat Oncol Biol Phys* 1984;10(7):1109–1115.
87. Phillips TL, Buschke F. Radiation tolerance of the thoracic spinal cord. *Am J Roentgenol Radium Ther Nucl Med* 1969;105(3):659–664.
88. Wara WM, Phillips TL, Sheline GE, et al. Radiation tolerance of the spinal cord. *Cancer* 1975;35(6):1558–1562.
89. Kirkpatrick JP, van der Kogel AJ, Schultheiss TE. Radiation dose-volume effects in the spinal cord. *Int J Radiat Oncol Biol Phys* 2010;76(3 Suppl):S42–S49.
90. Chao MW, Wirth A, Ryan G, et al. Radiation myelopathy following transplantation and radiotherapy for non-Hodgkin's lymphoma. *Int J Radiat Oncol Biol Phys* 1998;41(5):1057–1061.
91. Seddon BM, Cassoni AM, Galloway MJ, et al. Fatal radiation myelopathy after high-dose busulfan and melphalan chemotherapy and radiotherapy for Ewing's sarcoma: a review of the literature and implications for practice. *Clin Oncol* 2005;17(5):385–390.
92. Townsend N, Handler M, Fleitz J, et al. Intramedullary spinal cord astrocytomas in children. *Pediatr Blood Cancer* 2004;43(6):629–632.
93. Bijl HP, van Luijk P, Coppes RP, et al. Regional differences in radiosensitivity across the rat cervical spinal cord. *Int J Radiat Oncol Biol Phys* 2005;61(2):543–551.
94. Ang KK, Jiang GL, Feng Y, et al. Extent and kinetics of recovery of occult spinal cord injury. *Int J Radiat Oncol Biol Phys* 2001;50(4):1013–1020.
95. Ang KK, Price RE, Stephens LC, et al. The tolerance of primate spinal cord to re-irradiation. *Int J Radiat Oncol Biol Phys* 1993;25(3):459–464.
96. Milano MT, Usuki KY, Walter KA, et al. Stereotactic radiosurgery and hypofractionated stereotactic radiotherapy: normal tissue dose constraints of the central nervous system. *Cancer Treat Rev* 2011;37(7):567–578.