



BÖLÜM 18

Akciğerin Depo Hastalıkları

Hale KIVRAK¹

GİRİŞ

Metabolik hastalıklar ve depo hastalıkları, altta yatan biyokimyasal veya metabolik işlev bozuklukları ile karakterize bir grup hastalıktan oluşur. Bu bozuklukların çoğu ya spesifik olarak ya da sistemik bir sendromun parçası olarak akciğerleri etkiler. Örneğin, amiloidoz trakeobronşiyal ağaçla sınırlı olabileceği gibi; böbrekleri, akciğerleri ve kalbi etkileyen sistemik bir hastalık şeklinde de bulgu verebilir. Bu hastalık gruplarında bazen karşılaşılan hızlı progresyon ve nonspesifik klinik semptomlar, tanışal zorluklara neden olabilir.

Görüntüleme yöntemleri, özellikle yüksek çözünürlüklü bilgisayarlı tomografi (HRCT), bu gibi zorlu klinik durumların teşhisinde oldukça faydalıdır. Bu hastalık grubunun radyolojik ve histopatolojik bulgularının korelasyonu, bu bozuklukların anlaşılması sağlar. Bilgisayarlı tomografi (BT), doku örneklemesi gerektiğinde girişimsel radyoloğa kılavuzluk ederek, histopatolojik tanıya da yardımcı olabilir.

Akciğerin depo hastalıkları, oldukça nadir antitelerdir. Pulmoner hastalık en sık sistemik hastalığın akciğer tutulumunun yansımasıdır. Akciğerin depo hastalıkları denilince akla pulmoner alveolar mikrolitiazis, pulmoner amiloidoz, pulmoner alveolar proteinoz, Niemann-Pick hastalığı ve Gaucher hastalığı gelmektedir.

¹ Uzm. Dr., Ankara Etlik Zübeyde Hanım Kadın Hastalıkları Eğitim ve Araştırma Hastanesi, Patoloji , karadag.hale@gmail.com, ORCID iD: 0000-0002-1637-7553

Asit sfingomiyelinaz eksikliği için spesifik bir tedavi şu anda mevcut değildir. Bununla birlikte, ERT tip B Niemann-Pick hastalığı olan hastalar için yararlı olabilir. Akciğer tutulumunu tedavi etmek için hematopoietik kök hücre naklinin pulmoner infiltratları başarılı bir şekilde azalttığı bildirilmiştir. Lipoid pnömoni için klasik bir tedavi olan tüm akciğer lavajının, özellikle yetişkinlerde, tip B Niemann-Pick hastalığı için nispeten etkili bir tedavi olduğu da bildirilmiştir (97). Ayrıca literatürde akciğer nakli yapılmış hastalara ait vaka sunumları da bulunmaktadır (103).

KAYNAKLAR

- Dogan A. Amyloidosis: Insights from Proteomics. *Annu Rev Pathol.* 2017;12:277-304.
- Sipe JD, Benson MD, Buxbaum JN, Ikeda S, Merlini G, Saraiva MJ, et al. Nomenclature 2014: Amyloid fibril proteins and clinical classification of the amyloidosis. *Amyloid.* 2014;21(4):221-4.
- Tuglular S, Yalcinkaya F, Paydas S, Oner A, Utas C, Bozfakioglu S, et al. A retrospective analysis for aetiology and clinical findings of 287 secondary amyloidosis cases in Turkey. *Nephrol Dial Transplant.* 2002;17(11):2003-5.
- Vrana JA, Gamez JD, Madden BJ, Theis JD, Bergen HR, 3rd, Dogan A. Classification of amyloidosis by laser microdissection and mass spectrometry-based proteomic analysis in clinical biopsy specimens. *Blood.* 2009;114(24):4957-9.
- Graham CM, Stern EJ, Finkbeiner WE, Webb WR. High-resolution CT appearance of diffuse alveolar septal amyloidosis. *AJR Am J Roentgenol.* 1992;158(2):265-7.
- Howard ME, Ireton J, Daniels F, Langton D, Manolitsas ND, Fogarty P, et al. Pulmonary presentations of amyloidosis. *Respirology.* 2001;6(1):61-4.
- Roden AC, Aubry MC, Zhang K, Brady JO, Levin D, Dogan A, et al. Nodular senile pulmonary amyloidosis: a unique case confirmed by immunohistochemistry, mass spectrometry, and genetic study. *Hum Pathol.* 2010;41(7):1040-5.
- Utz JP, Swensen SJ, Gertz MA. Pulmonary amyloidosis. The Mayo Clinic experience from 1980 to 1993. *Ann Intern Med.* 1996;124(4):407-13.
- Aichaouia C, Ben Meftah MR, M'Hamdi S, Laabidi J, Moatamri Z, Haddaoui A, et al. [Pleural amyloidosis attesting to generalised amyloidosis]. *Rev Pneumol Clin.* 2010;66(3):204-8.
- Czeyda-Pommersheim F, Hwang M, Chen SS, Strollo D, Fuhrman C, Bhalla S. Amyloidosis: Modern Cross-sectional Imaging. *Radiographics.* 2015;35(5):1381-92.
- Ueda M, Ando Y, Haraoka K, Katsuragi S, Terasaki Y, Sugimoto M, et al. Aging and transthyretin-related amyloidosis: pathologic examinations in pulmonary amyloidosis. *Amyloid.* 2006;13(1):24-30.
- Khoor A, Colby TV. Amyloidosis of the Lung. *Arch Pathol Lab Med.* 2017;141(2):247-54.
- Thompson PJ, Citron KM. Amyloid and the lower respiratory tract. *Thorax.* 1983;38(2):84-7.
- Renapurkar RD, Kanne JP. Metabolic and storage lung diseases: spectrum of imaging appearances. *Insights Imaging.* 2013;4(6):773-85.
- Chen KT. Amyloidosis presenting in the respiratory tract. *Pathol Annu.* 1989;24 Pt 1:253-73.
- Rodrigues K, Neves FS, Stoeterau KB, Werner Castro GR, Nobre LF, Zimmermann AF, et al. Pulmonary amyloidosis in Sjogren's syndrome: a rare diagnosis for nodular lung lesions. *Int J Rheum Dis.* 2009;12(4):358-60.
- Grogg KL, Aubry MC, Vrana JA, Theis JD, Dogan A. Nodular pulmonary amyloidosis is characterized by localized immunoglobulin deposition and is frequently associated with an indo-

- lent B-cell lymphoproliferative disorder. Am J Surg Pathol. 2013;37(3):406-12.
18. Himmelfarb E, Wells S, Rabinowitz JG. The radiologic spectrum of cardiopulmonary amyloidosis. Chest. 1977;72(3):327-32.
 19. Ayuso MC, Gilabert R, Bombi JA, Salvador A. CT appearance of localized pulmonary amyloidosis. J Comput Assist Tomogr. 1987;11(1):197-9.
 20. O'Regan A, Fenlon HM, Beamis JF, Jr, Steele MP, Skinner M, Berk JL. Tracheobronchial amyloidosis. The Boston University experience from 1984 to 1999. Medicine (Baltimore). 2000;79(2):69-79.
 21. Capizzi SA, Betancourt E, Prakash UB. Tracheobronchial amyloidosis. Mayo Clin Proc. 2000;75(11):1148-52.
 22. Kirbas G, Dagli CE, Tanrikulu AC, Yildiz F, Bekte Y, Senyigit A, et al. Unusual combination of tracheobronchopathia osteochondroplastica and AA amyloidosis. Yonsei Med J. 2009;50(5):721-4.
 23. Kirchner J, Jacobi V, Kardos P, Kollath J. CT findings in extensive tracheobronchial amyloidosis. Eur Radiol. 1998;8(3):352-4.
 24. Kim HY, Im JG, Song KS, Lee KS, Kim SJ, Kim JS, et al. Localized amyloidosis of the respiratory system: CT features. J Comput Assist Tomogr. 1999;23(4):627-31.
 25. Mekinian A, Jaccard A, Soussan M, Launay D, Berthier S, Federici L, et al. 18F-FDG PET/CT in patients with amyloid light-chain amyloidosis: case-series and literature review. Amyloid. 2012;19(2):94-8.
 26. Schaadt BK, Hendel HW, Gimsing P, Jonsson V, Pedersen H, Hesse B. 99mTc-aprotinin scintigraphy in amyloidosis. J Nucl Med. 2003;44(2):177-83.
 27. Lin FC, Chang GD, Chern MS, Chen YC, Chang SC. Clinical significance of anti-GM-CSF antibodies in idiopathic pulmonary alveolar proteinosis. Thorax. 2006;61(6):528-34.
 28. Yusen RD, Cohen AH, Hamvas A. Normal lung function in subjects heterozygous for surfactant protein-B deficiency. Am J Respir Crit Care Med. 1999;159(2):411-4.
 29. Presneill JJ, Nakata K, Inoue Y, Seymour JF. Pulmonary alveolar proteinosis. Clin Chest Med. 2004;25(3):593-613, viii.
 30. Doerschuk CM. Pulmonary alveolar proteinosis--is host defense awry? N Engl J Med. 2007;356(6):547-9.
 31. Uchida K, Beck DC, Yamamoto T, Berclaz PY, Abe S, Staudt MK, et al. GM-CSF autoantibodies and neutrophil dysfunction in pulmonary alveolar proteinosis. N Engl J Med. 2007;356(6):567-79.
 32. Ioachimescu OC, Kavuru MS. Pulmonary alveolar proteinosis. Chron Respir Dis. 2006;3(3):149-59.
 33. Jouneau S, Menard C, Lederlin M. Pulmonary alveolar proteinosis. Respirology. 2020;25(8):816-26.
 34. Seymour JF, Presneill JJ. Pulmonary alveolar proteinosis: progress in the first 44 years. Am J Respir Crit Care Med. 2002;166(2):215-35.
 35. Burbank B, Morrione TG, Cutler SS. Pulmonary alveolar proteinosis and nocardiosis. Am J Med. 1960;28:1002-7.
 36. Rosen SH, Castleman B, Liebow AA. Pulmonary alveolar proteinosis. N Engl J Med. 1958;258(23):1123-42.
 37. Murch CR, Carr DH. Computed tomography appearances of pulmonary alveolar proteinosis. Clin Radiol. 1989;40(3):240-3.
 38. Lee KN, Levin DL, Webb WR, Chen D, Storto ML, Golden JA. Pulmonary alveolar proteinosis: high-resolution CT, chest radiographic, and functional correlations. Chest. 1997;111(4):989-95.
 39. Prakash UB, Barham SS, Carpenter HA, Dines DE, Marsh HM. Pulmonary alveolar phospholipoproteinosis: experience with 34 cases and a review. Mayo Clin Proc. 1987;62(6):499-518.

40. Godwin JD, Muller NL, Takasugi JE. Pulmonary alveolar proteinosis: CT findings. Radiology. 1988;169(3):609-13.
41. Holbert JM, Costello P, Li W, Hoffman RM, Rogers RM. CT features of pulmonary alveolar proteinosis. AJR Am J Roentgenol. 2001;176(5):1287-94.
42. Kang EY, Grenier P, Laurent F, Muller NL. Interlobular septal thickening: patterns at high-resolution computed tomography. J Thorac Imaging. 1996;11(4):260-4.
43. Johkoh T, Itoh H, Muller NL, Ichikado K, Nakamura H, Ikezoe J, et al. Crazy-paving appearance at thin-section CT: spectrum of disease and pathologic findings. Radiology. 1999;211(1):155-60.
44. Frazier AA, Franks TJ, Cooke EO, Mohammed TL, Pugatch RD, Galvin JR. From the archives of the AFIP: pulmonary alveolar proteinosis. Radiographics. 2008;28(3):883-99; quiz 915.
45. Murayama S, Murakami J, Yabuuchi H, Soeda H, Masuda K. "Crazy paving appearance" on high resolution CT in various diseases. J Comput Assist Tomogr. 1999;23(5):749-52.
46. Choi HK, Park CM, Goo JM, Lee HJ. Pulmonary alveolar proteinosis versus exogenous lipid pneumonia showing crazy-paving pattern: Comparison of their clinical features and high-resolution CT findings. Acta Radiol. 2010;51(4):407-12.
47. Lee CH. The crazy-paving sign. Radiology. 2007;243(3):905-6.
48. Xu Z, Jing J, Wang H, Xu F, Wang J. Pulmonary alveolar proteinosis in China: a systematic review of 241 cases. Respirology. 2009;14(5):761-6.
49. Castellana G, Castellana G, Gentile M, Castellana R, Resta O. Pulmonary alveolar microlithiasis: review of the 1022 cases reported worldwide. Eur Respir Rev. 2015;24(138):607-20.
50. Saito A, McCormack FX. Pulmonary Alveolar Microlithiasis. Clin Chest Med. 2016;37(3):441-8.
51. Corut A, Senyigit A, Ugur SA, Altin S, Ozcelik U, Calisir H, et al. Mutations in SLC34A2 cause pulmonary alveolar microlithiasis and are possibly associated with testicular microlithiasis. Am J Hum Genet. 2006;79(4):650-6.
52. Huqun, Izumi S, Miyazawa H, Ishii K, Uchiyama B, Ishida T, et al. Mutations in the SLC34A2 gene are associated with pulmonary alveolar microlithiasis. Am J Respir Crit Care Med. 2007;175(3):263-8.
53. Mariotta S, Ricci A, Papale M, De Clementi F, Sposito B, Guidi L, et al. Pulmonary alveolar microlithiasis: report on 576 cases published in the literature. Sarcoidosis Vasc Diffuse Lung Dis. 2004;21(3):173-81.
54. Shaw BM, Shaw SD, McCormack FX. Pulmonary Alveolar Microlithiasis. Semin Respir Crit Care Med. 2020;41(2):280-7.
55. Khaladkar SM, Kondapavuluri SK, Kamal A, Kalra R, Kuber R. Pulmonary Alveolar Microlithiasis - Clinico-Radiological dissociation - A case report with Radiological review. J Radiol Case Rep. 2016;10(1):14-21.
56. Krishnakurup J, Abdelsayed G. The calcareous lung. Mayo Clin Proc. 2011;86(2):85.
57. Ferreira Francisco FA, Pereira e Silva JL, Hochhegger B, Zanetti G, Marchiori E. Pulmonary alveolar microlithiasis. State-of-the-art review. Respir Med. 2013;107(1):1-9.
58. Jonsson ALM, Bendstrup E, Mogensen S, Kopras EJ, McCormack FX, Campo I, et al. Eight novel variants in the SLC34A2 gene in pulmonary alveolar microlithiasis. Eur Respir J. 2020;55(2).
59. Jonsson AL, Hilberg O, Bendstrup EM, Mogensen S, Simonsen U. SLC34A2 gene mutation may explain comorbidity of pulmonary alveolar microlithiasis and aortic valve sclerosis. Am J Respir Crit Care Med. 2012;185(4):464.
60. Kiatboonsri S, Charoenpan P, Vathesatogkit P, Boonpucknavig V. Pulmonary alveolar microlithiasis: report of five cases and literature review. J Med Assoc Thai. 1985;68(12):672-7.
61. Alkhankan E, Yamin H, Bukamur H, Alkhankan F, Shweihat Y, Zeid F. Pulmonary alveolar microlithiasis diagnosed with radiography, CT, and bone scintigraphy. Radiol Case Rep. 2019;14(6):775-7.

62. Gasparetto EL, Tazonero P, Escuissato DL, Marchiori E, Frare ESRL, Sakamoto D. Pulmonary alveolar microlithiasis presenting with crazy-paving pattern on high resolution CT. *Br J Radiol.* 2004;77(923):974-6.
63. Francisco FA, Rodrigues RS, Barreto MM, Escuissato DL, Araujo Neto CA, Silva JL, et al. Can chest high-resolution computed tomography findings diagnose pulmonary alveolar microlithiasis? *Radiol Bras.* 2015;48(4):205-10.
64. Deniz O, Ors F, Tozkoparan E, Ozcan A, Gumus S, Bozlar U, et al. High resolution computed tomographic features of pulmonary alveolar microlithiasis. *Eur J Radiol.* 2005;55(3):452-60.
65. Aljishi A, Al-Badr SH, Aldaoud N, Abdulqawi R. Precalcific phase of pulmonary alveolar microlithiasis. *BMJ Case Rep.* 2022;15(7).
66. Little BP. Sarcoidosis: overview of pulmonary manifestations and imaging. *Semin Roentgenol.* 2015;50(1):52-64.
67. Kosciuk P, Meyer C, Wikenheiser-Brokamp KA, McCormack FX. Pulmonary alveolar microlithiasis. *Eur Respir Rev.* 2020;29(158).
68. Tao LC. Microliths in sputum specimens and their relationship to pulmonary alveolar microlithiasis. *Am J Clin Pathol.* 1978;69(5):482-5.
69. Martinez-Giron R, Martinez-Torre S, Tamargo-Pelaez ML, Lopez-Cabanilles MD, Torre-Bayon C. Calcareous concretions and psammoma bodies in sputum smears: do these similar structures have different clinical significance? *Diagn Cytopathol.* 2014;42(9):759-65.
70. Martinez-Giron R, Martinez-Torre S. Calcified Curschmann's spirals and microliths in sputum smears from a case of pulmonary alveolar microlithiasis. *Diagn Cytopathol.* 2017;45(12):1116-8.
71. Salisbury JR, Darby AJ, Whimster WF. Papillary adenocarcinoma of lung with psammoma bodies: report of a case derived from type II pneumocytes. *Histopathology.* 1986;10(8):877-84.
72. Bendstrup E, Jonsson ALM. Pulmonary alveolar microlithiasis: no longer in the stone age. *ERJ Open Res.* 2020;6(3).
73. Tachibana T, Hagiwara K, Johkoh T. Pulmonary alveolar microlithiasis: review and management. *Curr Opin Pulm Med.* 2009;15(5):486-90.
74. Guillemot N, Troadec C, de Villemeur TB, Clement A, Fauroux B. Lung disease in Niemann-Pick disease. *Pediatr Pulmonol.* 2007;42(12):1207-14.
75. Jezela-Stanek A, Chorostowska-Wynimko J, Tylki-Szymanska A. Pulmonary involvement in selected lysosomal storage diseases and the impact of enzyme replacement therapy: A state-of-the art review. *Clin Respir J.* 2020;14(5):422-9.
76. Gulhan B, Ozcelik U, Gurakan F, Gucer S, Orhan D, Cinel G, et al. Different features of lung involvement in Niemann-Pick disease and Gaucher disease. *Respir Med.* 2012;106(9):1278-85.
77. Beutler E. Gaucher disease. *Curr Opin Hematol.* 1997;4(1):19-23.
78. Messner MC, Cabot MC. Glucosylceramide in humans. *Adv Exp Med Biol.* 2010;688:156-64.
79. Stirnemann J, Vigan M, Hamroun D, Heraoui D, Rossi-Semerano L, Berger MG, et al. The French Gaucher's disease registry: clinical characteristics, complications and treatment of 562 patients. *Orphanet J Rare Dis.* 2012;7:77.
80. Nagral A. Gaucher disease. *J Clin Exp Hepatol.* 2014;4(1):37-50.
81. Borie R, Crestani B, Guyard A, Lidove O. Interstitial lung disease in lysosomal storage disorders. *Eur Respir Rev.* 2021;30(160).
82. Sherwani P, Vire A, Anand R, Gupta R. Lung lysed: A case of Gaucher disease with pulmonary involvement. *Lung India.* 2016;33(1):108-10.
83. Yassa NA, Wilcox AG. High-resolution CT pulmonary findings in adults with Gaucher's disease. *Clin Imaging.* 1998;22(5):339-42.
84. Copley SJ, Coren M, Nicholson AG, Rubens MB, Bush A, Hansell DM. Diagnostic accuracy of thin-section CT and chest radiography of pediatric interstitial lung disease. *AJR Am J Roentgenol.* 2000;174(2):549-54.
85. Roberts WC, Fredrickson DS. Gaucher's disease of the lung causing severe pulmonary hypertension with associated acute recurrent pericarditis. *Circulation.* 1967;35(4):783-9.

86. Kim JH, Park CH, Pai MS, Hahn MH, Kim HJ. Hepatopulmonary syndrome in Gaucher disease with right-to-left shunt: evaluation and measurement using Tc-99m MAA. *Clin Nucl Med.* 1999;24(3):164-6.
87. Aydin K, Karabulut N, Demirkazik F, Arat A. Pulmonary involvement in adult Gaucher's disease: high resolution CT appearance. *Br J Radiol.* 1997;70:93-5.
88. Wolson AH. Pulmonary findings in Gaucher's disease. *Am J Roentgenol Radium Ther Nucl Med.* 1975;123(4):712-5.
89. Tunaci A, Berkmen YM, Gokmen E. Pulmonary Gaucher's disease: high-resolution computed tomographic features. *Pediatr Radiol.* 1995;25(3):237-8.
90. Ho MW, Seck J, Schmidt D, Veath ML, Johnson W, Brady RO, et al. Adult Gaucher's disease: kindred studies and demonstration of a deficiency of acid beta-glucuronidase in cultured fibroblasts. *Am J Hum Genet.* 1972;24(1):37-45.
91. Barton NW, Brady RO, Dambrosia JM, Di Bisceglie AM, Doppelt SH, Hill SC, et al. Replacement therapy for inherited enzyme deficiency--macrophage-targeted glucocerebrosidase for Gaucher's disease. *N Engl J Med.* 1991;324(21):1464-70.
92. Meikle PJ, Hopwood JJ, Clague AE, Carey WF. Prevalence of lysosomal storage disorders. *JAMA.* 1999;281(3):249-54.
93. Thurm A, Chlebowski C, Joseph L, Farmer C, Adedipe D, Weiss M, et al. Neurodevelopmental Characterization of Young Children Diagnosed with Niemann-Pick Disease, Type C1. *J Dev Behav Pediatr.* 2020;41(5):388-96.
94. Ferreira CR, Gahl WA. Lysosomal storage diseases. *Transl Sci Rare Dis.* 2017;2(1-2):1-71.
95. Eskes ECB, Sjouke B, Vaz FM, Goorden SMI, van Kuilenburg ABP, Aerts J, et al. Biochemical and imaging parameters in acid sphingomyelinase deficiency: Potential utility as biomarkers. *Mol Genet Metab.* 2020;130(1):16-26.
96. Sevin M, Lesca G, Baumann N, Millat G, Lyon-Caen O, Vanier MT, et al. The adult form of Niemann-Pick disease type C. *Brain.* 2007;130(Pt 1):120-33.
97. von Ranke FM, Pereira Freitas HM, Mancano AD, Rodrigues RS, Hochhegger B, Escuissato D, et al. Pulmonary Involvement in Niemann-Pick Disease: A State-of-the-Art Review. *Lung.* 2016;194(4):511-8.
98. Mendelson DS, Wasserstein MP, Desnick RJ, Glass R, Simpson W, Skloot G, et al. Type B Niemann-Pick disease: findings at chest radiography, thin-section CT, and pulmonary function testing. *Radiology.* 2006;238(1):339-45.
99. Lachman R, Crocker A, Schulman J, Strand R. Radiological findings in Niemann-Pick disease. *Radiology.* 1973;108(3):659-64.
100. Freitas HMP, Mancano AD, Rodrigues RS, Hochhegger B, Torres P, Escuissato D, et al. Niemann-Pick disease type B: HRCT assessment of pulmonary involvement. *J Bras Pneumol.* 2017;43(6):451-455.
101. Sousa Martins R, Rocha S, Guimas A, Ribeiro R. Niemann-Pick Type B: A Rare Cause of Interstitial Lung Disease. *Cureus.* 2022;14(1):e21230.
102. McGovern MM, Dionisi-Vici C, Giugliani R, Hwu P, Lidove O, Lukacs Z, et al. Consensus recommendation for a diagnostic guideline for acid sphingomyelinase deficiency. *Genet Med.* 2017;19(9):967-74.
103. O'Neill RS, Belousova N, Malouf MA. Pulmonary Type B Niemann-Pick Disease Successfully Treated with Lung Transplantation. *Case Rep Transplant.* 2019;2019:9431751.