

Bölüm 65

PULMONER ANJİYOĞRAFI

Murat KERKÜTLÜOĞLU¹
Hakan GÜNEŞ²

Pulmoner arterler, farklı yöntemlerle değerlendirilebilir. Tarihsel olarak, sıklıkla şüpheli pulmoner emboli (PE) tanısında kateter aracılı pulmoner anjiyografi kullanılmıştır. Bununla birlikte, son yirmi yılda kateter anjiyografisi, üstün duyarlılığı ve özgüllüğü nedeniyle Bilgisayarlı Tomografi Anjiyografisi (BTA)'ne yerini bırakmıştır (1). Manyetik Rezonans ve Ventilasyon/Perfüzyon taramaları gibi diğer invaziv olmayan yöntemler de, pulmoner arter anatomisini ve hemodinamiğini değerlendirmek için kullanılmaktadır (2). Günümüzde konvansiyonel pulmoner anjiyografinin ana klinik faydası, terapötik müdahale ve seçilmiş vakalarda pulmoner arterlerin preoperatif değerlendirilmesi içindir.

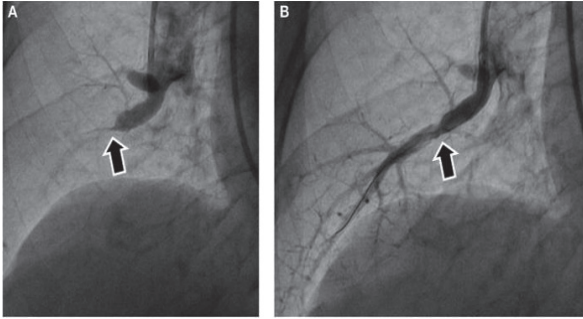
Pulmoner arter anatomisi

Geniş kapiller yatak ve seri olarak bağlanan pulmoner venöz ağaçtan oluşan pulmoner arteriyel dolaşım, gaz değişimi için geniş bir yüzey alanı sağlayan düşük basınçlı, yüksek kapasitanslı bir sistemdir. Ana pulmoner arter, sağ ventrikül çıkış yolundan kaynaklanır ve aorttan arkaya ve sola doğru ilerler (3). Aortik arkın altında, karına seviyesinde sağ ve sol ana pulmoner arterlere çatallanır. Sağ ve sol pulmoner arterler, her biri 2 lobe dala ve ardından segmenter ve alt segmenter dallara ayrılır (Şekil-1).

Sağ pulmoner arter, perikard içinde medias-tende yatay olarak seyrederek sağ ana kök bronşun önünden asendan aortanın arkasından ve vena kavanın üstünden seyrederek. Perikarddan ayrılırken sağ ana kök bronşun önünde uzanır. İlk dalının orijininin sonra trunkus anterior, interlobar pulmoner arter, arkadan bronkus medius ile anterior arasında aşağı doğru uzanır. Orta lob bronşunun kökeni arkasından arkaya döner, ortak bazal gövde olarak devam eder ve bazal segmentlere doğru sonlanır. Trunkus anterior sağ üst lobu besler ve interlobar fissürde seyreden interlobar arter, sağ orta ve sağ alt lobları besler. Sağ üst lobun segmenter arterleri, en yaygın arteriyel paternde, apikal ve anterior segmentleri besleyen tek anterior gövde veya trunkus anterior bulunurken, arka segmenti besleyen tek dal bulunur. Diğer yaygın varyantlar apikal, anterior ve posterior segmentleri beslemek için trunkus anteriorun trifurkasyonunu ve posterior segmente 2 ayrı dalın bulunmasını içerir. Bazen, üst lob için orta lobdan segmenter besleme veya üst segment sağ alt lob arteri olabilir. Sağ orta lobda segmenter arterler; orta lob segmenter arterleri, sağ interlobar arterin anteromedial yönünden kaynaklanır çünkü bronş aralığına anterior ilerler. Arterlerin orta lobun medial ve lateral segmentlerine ayrı veya ortak orijini olabilir. Sağ alt lobda segmenter arterler, tipik olarak, sağ alt

¹ Arş. Gör. Dr. Murat KERKÜTLÜOĞLU, Kahramanmaraş Sütçüimam Üniversitesi, Tıp Fakültesi, Kardiyoloji Anabilim Dalı
drmuratkerk@gmail.com

² Dr. Öğretim Üyesi Hakan GÜNEŞ, Kahramanmaraş Sütçüimam Üniversitesi, Tıp Fakültesi, Kardiyoloji Anabilim Dalı
drhakangunes83@gmail.com



Şekil-2. Balon pulmoner anjiyoplasti öncesi ve sonrası pulmoner anjiyografi (39)

Anahtar Kelimeler: pulmoner anjiyografi, balon pulmoner anjiyoplasti, pulmoner emboli, kteph

KAYNAKÇA

1. Yazdani M, Lau CT, Lempel JK, et al. Historical Evolution of Imaging Techniques for the Evaluation of Pulmonary Embolism: RSNA Centennial Article. *Radiographics*. 2015 Jul-Aug. 35 (4):1245-62.
2. Kreitner KF, Ley S, Kauczor HU, et al. Chronic thromboembolic pulmonary hypertension: pre- and postoperative assessment with breath-hold MR imaging techniques. *Radiology*. 2004 Aug. 232(2):535-43.
3. Frechette E, Deslauriers J. Surgical anatomy of the bronchial tree and pulmonary artery. *Semin Thorac Cardiovasc Surg* 2006;18:77-84. 10.1053/j.semtcvs.2006.06.002
4. Kandathil A, Chamrathy M. Pulmonary vascular anatomy & anatomical variants. *Cardiovasc Diagn Ther*. 2018 Jun;8(3):201-207. doi: 10.21037/cdt.2018.01.04.
5. Joseph S, Alpert, Roger Smith, C. Jeffrey Carlson, et al. Mortality in Patients Treated for Pulmonary Embolism *JAMA*. 1976;236(13):1477-1480. doi:10.1001/jama.1976.03270140029017
6. Klok FA, Mos IC, van Kralingen KW, Vahl JE, Huisman MV. Chronic pulmonary embolism and pulmonary hypertension. *Semin Respir Crit Care Med*. 2012 Apr. 33(2):199-204
7. Fava M, Loyola S, Huete I. Massive pulmonary embolism: treatment with the hydrolyser thrombectomy catheter. *J Vasc Interv Radiol*. 2000 Oct;11(9):1159-64.
8. Banovac F, Buckley DC, Kuo WT, et al. Reporting standards for endovascular treatment of pulmonary embolism. *J Vasc Interv Radiol*. 2010 Jan. 21(1):44-53.
9. Prasad V, Chan RP, Faughnan ME. Embolotherapy of pulmonary arteriovenous malformations: efficacy of platinum versus stainless steel coils. *J Vasc Interv Radiol*. 2004 Feb. 15(2 Pt 1):153-60.
10. Yamakado K, Takaki H, Takao M, et al. Massive hemoptysis from pulmonary artery pseudoaneurysm caused by lung radiofrequency ablation: successful treatment by coil embolization. *Cardiovasc Intervent Radiol*. 2010 Apr. 33(2):410-2.
11. Tam MD, Spain J, Lieber M, et al. Fracture and distant migration of the Bard Recovery filter: a retrospective review of 363 implantations for potentially life-threatening

complications. *J Vasc Interv Radiol*. 2012 Feb. 23(2):199-205.e1.

12. ACR- SIR Practice Guideline for the performance of diagnostic arteriography in adults, Resolution 9, 2007re-revision. http://www.acr.org/~media/ACR/Documents/PGTS/guidelines/Diagnostic_Arteriography.pdf Accessed 06/18/2012.
13. Nilsson T, Carlsson A, Måre K. Pulmonary angiography: a safe procedure with modern contrast media and technique. *Eur Radiol*. 1998. 8(1):86-9
14. Reilly BK, Friedman A, Nasrallah EJ, Elkind MS. Bi-hemispheric stroke complicating right pulmonary angiography. *J Vasc Interv Radiol*. 2003 Sep. 14(9 Pt 1):1211-3
15. SELDINGER SI. Catheter replacement of the needle in percutaneous arteriography; a new technique. *Acta radiol*. 1953 May;39(5):368-76.
16. Bagla S, Smirniotopoulos JB, van Breda A, et al. Ultrasound-accelerated catheter-directed thrombolysis for acute submassive pulmonary embolism. *J Vasc Interv Radiol*. 2015 Jul. 26 (7):1001-6.
17. Beachley MC, Tisnado J, Konerding K, et al. Alternate technique for pulmonary arteriography. *AJR Am J Roentgenol*. 1980 Jan. 134(1):195-6.
18. McLellan GL, Scalapino MC. Pulmonary artery catheterization: a modified technique. *Radiology*. 1988 Oct. 169(1):264-5.
19. Grollman JH, Renner JW. Transfemoral pulmonary angiography: update on technique. *AJR Am J Roentgenol*. 1981 Mar. 136(3):624-6.
20. Courey WR, deVillasante JM, Waltman AC. A quick, simple method of percutaneous transfemoral pulmonary arteriography. *Radiology*. 1974 Nov;113(2):475-7.
21. Mills CS, Van Aman ME. Modified technique for percutaneous transfemoral pulmonary angiography. *Cardiovasc Intervent Radiol*. 1986;9(1):52-3.
22. Tempkin DL, Ladika JE. New catheter design and placement technique for pulmonary arteriography. *Radiology*. 1987 Apr;163(1):275-6.
23. Moos JM, Ham SW, Han SM, et al. Safety of carbon dioxide digital subtraction angiography. *Arch Surg*. 2011 Dec. 146(12):1428-32.
24. Stein PD, Athanasoulis C, Alavi A, et al. Complications and validity of pulmonary angiography in acute pulmonary embolism. *Circulation*. 1992 Feb;85(2):462-8.
25. Musset D, Parent F, Meyer G, et al. Evaluation du Scanner Spirale dans l'Embolie Pulmonaire study group. Diagnostic strategy for patients with suspected pulmonary embolism: a prospective multicentre outcome study. *Lancet*. 2002 Dec 14;360(9349):1914-20.
26. Humbert M, Sitbon O, Simonneau G. Treatment of pulmonary arterial hypertension. *N Engl J Med*. 2004 Sep 30;351(14):1425-36.
27. He C, Von Segesser LK, Kappetein PA, et al. Acute pulmonary embolectomy. *Eur J Cardiothorac Surg* 2013;43:1087-95.
28. Kuo W, van den Bosch M, Hofmann L, et al. Catheter-directed embolectomy, fragmentation, and thrombolysis for the treatment of massive pulmonary embolism after failure of systemic thrombolysis. *Chest* 2008;134:250-4.
29. Kucher N, Boekstegers P, Muller OJ, et al. Randomized, controlled trial of ultrasound-assisted catheter-directed

- thrombolysis for acute intermediate-risk pulmonary embolism. *Circulation* 2014;129:479-86.
30. Engelberger RP, Kucher N. Ultrasound-assisted thrombolysis for acute pulmonary embolism: a systematic review. *EurHeart J* 2014;35:758-64.
 31. Greenfield LJ, Proctor MC, Williams DM, et al. Long-term experience with transvenous catheter pulmonary embolectomy. *J Vasc Surg.* 1993 Sep;18(3):450-7
 32. Todoran TM, Sobieszczyk PS, Levy MS, et al. Percutaneous extraction of right atrial mass using the Angiovac aspiration system. *J Vasc Interv Radiol.* 2011 Sep;22(9):1345-7. doi:10.1016/j.jvir.2011.04.004.
 33. Banovac F, Buckley DC, Kuo WT, et al. Technology Assessment Committee of the Society of Interventional Radiology. Reporting standards for endovascular treatment of pulmonary embolism. *J Vasc Interv Radiol.* 2010 Jan;21(1):44-53. doi:10.1016/j.jvir.2009.09.018.
 34. Schmitz-Rode T, Janssens U, Duda SH, et al. Massive pulmonary embolism: percutaneous emergency treatment by pigtail rotation catheter. *J Am Coll Cardiol.* 2000 Aug;36(2):375-80.
 35. Kanadaşı M, Tasal A, Demir M, et al. Masif pulmoner emboli olgusunda iliyak balon anjiyoplasti ile trombüs parçalanması. *Anadolu Kardiyol Derg* 2008;8(4): 306-14.
 36. Müller-Hülsbeck S, Brossmann J, Jahnke T, et al. Mechanical thrombectomy of major and massive pulmonary embolism with use of the Amplatz thrombectomy device. *Invest Radiol.* 2001 Jun;36(6):317-22.
 37. Horsch AD, van Oostayen J, Zeebregts CJ, et al. The Rotarex® and Aspirex® mechanical thrombectomy devices. *Surg Technol Int* 2009; 18:185-92.
 38. Engelhardt TC, Taylor AJ, Simprini LA, et al. Catheter-directed ultrasound-accelerated thrombolysis for the treatment of acute pulmonary embolism. *Thromb Res* 2011;128(2): 149-54.
 39. Ogawa A and Matsubara H. Balloon pulmonary angioplasty: a treatment option for inoperable patients with chronic thromboembolic pulmonary hypertension. *Front Cardiovasc. Med.* 2:4. doi: 10.3389/fcvm.2015.00004
 40. Ishiguro H, Kataoka M, Inami T, et al. Percutaneous transluminal pulmonary angioplasty for central-type chronic thromboembolic pulmonary hypertension. *JACC Cardiovasc Interv* (2013) 6(11):1212-3.10.1016/j.jcin.2013.03.025
 41. Feinstein JA, Goldhaber SZ, Lock JE, et al. Balloon pulmonary angioplasty for treatment of chronic thromboembolic pulmonary hypertension. *Circulation* (2001) 103(1):10-3.10.1161/01.CIR.103.1.10
 42. Mizoguchi H, Ogawa A, Munemasa M, et al. Refined balloon pulmonary angioplasty for inoperable patients with chronic thromboembolic pulmonary hypertension. *Circ Cardiovasc Interv* (2012) 5(6):748-55.
 43. Kataoka M, Inami T, Hayashida K, et al. Percutaneous transluminal pulmonary angioplasty for the treatment of chronic thromboembolic pulmonary hypertension. *Circ Cardiovasc Interv* (2012) 5(6):756-62.
 44. Andreassen AK, Ragnarsson A, Gude E, et al. Balloon pulmonary angioplasty in patients with inoperable chronic thromboembolic pulmonary hypertension. *Heart* (2013) 99(19):1415-20.
 45. Kerr KM, Auger WR, Marsh JJ, et al. Efficacy of methylprednisolone in preventing lung injury following pulmonary thromboendarterectomy. *Chest* (2012) 141(1):27-35.
 46. JCS Joint Working Group. Statement for balloon pulmonary angioplasty for chronic thromboembolic pulmonary hypertension (JCS 2014). [In Japanese] *Circ J* (Forthcoming).