

BÖLÜM 3

BAŞ BOYUN BÖLGESİNİN ARTERYEL ANATOMİSİ VE VARYASYONLAR

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GİRİŞ

Büyük damarlar ve dallarının anatomi ve varyasyonlarını anlayabilmek için öncelikle arkus aortanın embriyolojisinin bilinmesi gerekir. Arkus aorta ve dalları ventral aorta, dorsal aorta ve aortik arklardan gelişir. Bu arkların selektif apoptozisle gerilemesi sonucu rezidü dallar, arkus aorta ile ana dallarını oluşturur (1). Dorsal ve ventral aorta, kranio-kaudal olarak numaralandırılmış altı çift brankial ark ile birbirine bağlanır. Aort dallarını başlıca üçüncü, dördüncü ve altıncı arklar oluşturmaktadır. Üçüncü ve dördüncü ark arterlerini birbirine bağlayan dorsal aort segmentleri her iki tarafta kaybolur. Böylelikle kafa tüm kanını üçüncü aortik ark (AA) aracılığıyla alır. Üçüncü AA, ortak karotid arter (CCA), eksternal karotid arter (ECA) ve internal karotid arterin (ICA) ilk bölümünü oluşturmaktadır. ICA'nın kalan distal kesimi, dorsal aortanın kranial kesiminden oluşur. ICA, CCA ve ECA'nın dalı ve devamı olarak kabul edilir (2,3).

REMNANT DALLAR

1. ark: maksiller arterin 1. kısmı
2. ark: hyoid ve stapediaal arterin parçası
3. ark: CCA, ECA ve ICA'nın ilk bölümü
4. ark: AA ve sağ subklavian arterin parçası
5. ark: kaybolur
6. ark: sağ ve sol pulmoner arterin proksimal parçası ile ve duktus arteriozusun distal kesimi

Dorsal aorta oksipital, servikal ve torasik segmental dallar verir. Subklavian arteri (SCA) oluşturan segment dışında servikal dallar kaybolur. Arterler arasındaki longitudinal anastomozlar ise her iki tarafta vertebral arterleri (VA) oluştururlar (4). Resim 1 ve 2'de aorta ile dallarının gelişim süreci ve double AA modeli şematize edilmiştir.

Baş boyun arteriyel vaskülarizasyonu AA'daki üç ana arterden kaynaklanır: İlk ve en büyük dalı BCT'dir. Popülasyonun 2/3'ünde AA'dan orjin almaktadır. Sağ CCA, BCT bifurkasyonundan başlar. Sağ VA, BCT'nin dalı olan sağ SCA'dan kaynaklanır. AA'nın ikinci dalı sol CCA,

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KAYNAKLAR

1. Pinar YA, Govsa F, Celik S. Artyies of the Face and Neck. Watanabe K (ed). *Anatomy for Plastic Surgery of the Face, Head, and Neck*. Thieme; 2016. p. 47-62.
2. Shi S, Arterial Vascular Variation of the Head and Neck and Its Clinical Significance. *J Neurol Neurop-hysiol*. 2017, 8(4): 1000442.
3. Cappabianca S, Somma F, Negro A. Extracranial internal carotid artery: anatomical variations in asymptomatic patients. *Surg Radiol Anat*. 2016. 38(8):893-902.
4. Uchino A. *Atlas of the Supraaortic Craniocervical Arterial Variations*. Springer; 2022.
5. Berko NS, Jain VR, Godelman A, Stein EG, Ghosh S, Haramati LB. Variants and anomalies of thoracic vasculature on computed tomographic angiography in adults. *J Comput Assist Tomogr*. 2009;33:523-8.
6. Uchino A, Saito N, Takahashi M, Okada Y, Kozawa E, Nishi N, Mizukoshi W, Nakajima R, Watanabe Y. Variations in the origin of the vertebral artery and its level of entry into the transverse foramen diagnosed by CT angiography. *Neuroradiology*. 2013;55:585-94.
7. Muresian H. *Arterial Revascularization of the Head and Neck*. Springer; 2016.
8. Dessie M.A. Variations of the origin of superior thyroid artery and its relationship with the external branch of superior laryngeal nerve. *PLoS ONE*. 2018.13(5): 1-12.
9. Wacker F, Lippert H, Pabst R. *Arterial Variations in Humans: Key Reference for Radiologists and Surgeons*. Thieme; 2018.
10. Ovchinnikov N.A, Rao R.T, Rao S.R. Unilateral congenital elongation of the cervical part of the internal carotid artery with kinking and looping: two case reports and review of the literature. *Head & Face Medicine*.2007. 3(29). 1-14.
11. Gomibuchi T, Seto T, Yamamoto T, Nakahara K, Ohashi N, Ohtsu Y, Wada Y, Fukui D, Okada K. Surgical repair of cervical aortic arch with brain circulation anomaly through clamshell incision. *Ann Thorac Surg*. 2017;104:e235-7.
12. Gövsa FG, Sistematik Anatomi, Güven kitabevi, İzmir, 2003
13. Arıncı K, Elhan A. Anatomi, 2. cilt, 4. baskı, Güneş Kitabevi, Ankara 2006 (2): 299-303.
14. Harnsberger HR, Macdonald AJ. Diagnostic and surgical imaging anatomy, 1st edn, Brain, head and neck, spine. 2006. Amirsys, Salt Lake City.
15. Michalinos A, Chatzimarkos M, Arkadopoulos N, et al. Anatomical considerations on surgical anatomy of the carotid bifurcation. *Anat Res Int* 2016;2016:1-8.
16. Borges A, Ramalho S, Ferreira L. Common carotid artery trifurcation: a potentially dangerous anatomical variant. *BMJ Case Rep* 2021;14:e241104.
17. Uchino A. Bilateral brachiocephalic trunks. *Surg Radiol Anat*. 2018;40:1441-2.
18. Jakanani GC, Adair W. Frequency of variations in aortic arch anatomy depicted on multidetector CT. *Clin Radiol*. 2010;65:481-7.
19. Berko NS, Jain VR, Godelman A, Stein EG, Ghosh S, Haramati LB. Variants and anomalies of thoracic vasculature on computed tomographic angiography in adults. *J Comput Assist Tomogr*. 2009;33:523-8.
20. Layton KF, Kallmes DF, Cloft HJ, Lindell EP, Cox VS. Bovine aortic arch variant in humans: clarification of a common misnomer. *AJNR Am J Neuroradiol*. 2006;27:1541-2.
21. Ozgur Z, Govsa F, Ozgur T. Anatomic evaluation of the carotid artery bifurcation in cadavers: implications for open and endovascular therapy. *Surg Radiol Anat* 2008;30:475-80.
22. Ito H, Mataga I, Kageyama I, et al. Clinical anatomy in the neck region--the position of external and internal carotid arteries may be reversed. *Okajimas Folia Anat Jpn* 2006;82:157-67.
23. Ogeng'o JA, Misiani M, Malek A. Variant termination of the common carotid artery: cases of quadrifurcation and pentafurcation. *Anatomy Journal of Africa* 2014;3:386-92.
24. La Barbera G, La Marca G, Martino A. Kinking, coiling, and tortuosity of extracranial internal carotid artery: is it the effect of a metaplasia? *Surg Radiol Anat* 2006;28:573-80.
25. Nogueira TE, Chambers AA, Brueggemeyer MT, Miller TJ. Dual origin of the vertebral artery mimicking dissection. *AJNR Am J Neuroradiol*. 1997;18:382-4.
26. Weibel J, Fields WS: Tortuosity, coiling and kinking of the internal carotid artery. II. Relationship of morphological variation to cerebrovascular insufficiency. *Neurology*. 1965, 15:462-68.
27. Hacein-Bey L, Daniels D L, Ulmer J L et al. The ascending pharyngeal artery: branches, anastomoses, and clinical significance. *AJNR Am J Neuroradiol*. 2002 Aug;23(7):1246-56.
28. Togay-Isikay C, Kim J, Betterman K, Andrews C, Meads D, Tesh P, et al. Carotid artery tortuosity, kinking, coiling: stroke risk factor, marker, or curiosity? *Acta Neurol Belg*. 2005 Jun;105(2):68-72.
29. Zenteno M, Vinuela F, Moscote-Salazar LR, Alvis-Miranda H, Zavaleta R, Flores A, et al. Clinical implications of internal carotid artery tortuosity, kinking and coiling: a systematic review. *Romanian J Neurosurgery*. 2014; 21(1):50-59.
30. Ozgur Z, Celik S, Govsa F, Aktug H, Ozgur T. A study of the course of the internal carotid artery in the parapharyngeal space and its clinical importance. *Eur Arch Otorhinolaryngol* 2007;264(12):1483-9.
31. Fix TJ, Daffner RH, Deeb ZL. Carotid transposition: another cause of wide retropharyngeal soft tissues. *AJR Am J Roentgenol*. 1996 Nov; 167(5):1305-7.
32. Schenk P, Temmel A, Trattng S, Kainberger F (1996) Current aspects in diagnosis and therapy of carotid artery kinking. *HNO* 44:178-185.
33. Karcaaltincaba M, Haliloglu M, Ozkan E, Kocak M, Akinci D, Ariyurek M. Non-invasive imaging of aberrant right subclavian artery pathologies and aberrant right vertebral artery. *Br J Radiol*.2009;82:73-8.
34. Kaldararova M, Simkova I, Varga I, Tittel P, Kardos M, Ondriska M, Vrsanska V, Masura J. Double aortic

- arch anomalies in children: a systematic 20-year single center study. *Clin Anat.* 2017;30:929–39.
35. Rusu MC, Măru N, Rădoi PM, et al. Trifurcated external carotid artery and complete gamma-loop of its maxillary branch. *Surg Radiol Anat.* 2019; 41(2): 231–234.
 36. Ozgur Z, Govsa F, Ozgur T. Anatomic evaluation of the carotid artery bifurcation in cadavers: implications for open and endovascular therapy. *Surg Radiol Anat* 2008;30(6):475–480.
 37. Standring S. *Gray's Anatomy*, 40th ed. New York: Churchill Livingstone; 2009.
 38. Ozgur Z, Govsa F, Celik S, Ozgur T. Clinically relevant variations of the superior thyroid artery: an anatomic guide for surgical neck dissection. *Surg Radiol Anat* 2009;31(3):151–159.
 39. Troupis, T. G.; Dimitroulis, D.; Paraschos, A.; Michalinos, A.; Protogerou, V.; Vlasis, K.; Troupis, G. & Skandalakis, P. Lingual and facial arteries arising from the external carotid artery in a common trunk. *Am. Surg.*, 77(2):151-4, 2011.
 40. Jadhav, S. D.; Ambali, M. P. & Patil, R. J. Anatomical variation of the origin of the right lingual artery. *Int. J. Anat. Var.*, 4:75-6, 2011.
 41. Dhindsa GS, Sodhi S. Variation in the origin of superior thyroid artery. *Journal of Evolution of Medical and Dental Sciences.* 2014; 3(22):5969-72.
 42. Estrela F, Leão HZ, Jotz GP. Anatomic relation between the external branch of the superior laryngeal nerve and the thyroid gland. *Braz J Otorhinolaryngol.* 2011; 77(2):249-58. PMID: 21537628.
 43. Lohn JWG, Penn JW, Norton J, Butler PEM (2011) The course and variation of the facial artery and vein, implications for facial transplantation and facial surgery. *Ann Plast Surg* 67:184–188.
 44. Uysal II, Buyukmumcu M, Dogan NU, Seker M, Ziyilan T. Clinical significance of maxillary artery and its branches: A cadaver study and review of the literature. *Int. J. Morphol.* 2011; 29(4):1274-81.
 45. Bergman RA, Tubbs RS, Shoja MM, Loukas M, (2016). *Bergman's comprehensive encyclopedia of human anatomic variation*. Wiley, Hoboken. Standring S (2011)
 46. *Gray's anatomy*, 39th edn. Livingstone, Churchill.
 47. Cohen JE, Leker RR, Moshe Gomori J, et al. Pharyngooccipital artery variant arising proximal to occluded internal carotid artery: the risk of an unnecessary endarterectomy. *J Clin Neurosci* 2014; 21: 529–531.
 48. Uchino A, Saito N, Mizukoshi W, et al. Anomalous origin of the occipital artery diagnosed by magnetic resonance angiography. *Neuroradiology* 2011; 53: 853–857.
 49. Reinshagen L, Vodiskar J, Mühler E, Hövels-Gürich HH, Vazquez-Jimenez JF. Bicarotid trunk: how much is “not uncommon”? *Ann Thorac Surg.* 2014;97:945–9.
 50. Liang G, Gao X, Li Z, et al. Endovascular treatment for dural arteriovenous fistula at the foramen magnum: report of five consecutive patients and experience with balloon-augmented transarterial Onyx injection. *J Neuroradiol* 2013; 40: 134–139.
 51. Bacci D, Valecchi D, Sgambati E, et al. Compensatory collateral circles in vertebral and carotid artery occlusion. *Ital J Anat Embryol* 2008; 113: 265–271.
 52. Ates O, Ahmed AS, Niemann D, et al. The occipital artery for posterior circulation bypass: microsurgical anatomy. *Neurosurg Focus* 2008; 24: E9.
 53. Roski RA, Spetzler RF and Hopkins LN. Occipital artery to posterior inferior cerebellar artery bypass for vertebrobasilar ischemia. *Neurosurgery* 1982; 10: 44–49.
 54. Standring S (2011) *Gray's anatomy*, 39th edn. Livingstone, Churchill.
 55. Geibprasert S, Pongpech S, Armstrong D, Krings T (2009) Dangerous extracranial–intracranial anastomoses and supply to the cranial nerves: vessels the neurointerventionalist needs to know. *Am J Neuroradiol* 30:1459–1468.
 56. Meder JF, Blustajn J, Trystram D, et al. Radiologic anatomy of segmental agenesis of the internal carotid artery. *Surg Radiol Anat* 1997;19:385–394.
 57. Hong JT, Park DK, Lee MJ, Kim SW, An HS. Anatomical variations of vertebral artery segment in the lower cervical spine: analysis by three-dimensional computed tomography angiography. *Spine(Phila Pa 1976).* 2008 Oct 15; 33(22): 2224-6.
 58. Sanelli PC, Tong S, Gonzales RG, Eskey CJ. Normal variation of vertebral artery on CT angiography and its implications for diagnosis of acquired pathology. *J Comput Assist Tomogr.* 2002 May-Jun; 26(3):462-70.
 59. Peterson C, Philips L, Linden A, Hsu V. Vertebral artery hypoplasia: prevalence and reliability of identifying and grading its severity on magnetic resonance imaging scans. *J Manipulative Physiol Ther.* 2010 Mar-Apr; 33(3): 207-11.
 60. Puchner S, Haumer M, Rand T, Reiter M, Minar E, Lammer J, Bucek RA. CTA in the detection and quantification of vertebral artery pathologies: a correlation with color Doppler sonography. *Neuroradiol.* 2007 Aug; 49(8): 645-50. Epub 2007 Apr 24.
 61. Ionete C, Omojola MF. MR angiographic demonstration of bilateral duplication of the extracranial vertebral artery: unusual course and review of the literature. *AJNR Am J Neuroradiol.* 2006 Jun- Jul; 27(6): 1304-6.
 62. Weis J, Reul J, Mayfrank L, Ramaekers V, Thron A. Duplication of a vertebral artery associated with epidermoid cyst of the posterior fossa. *Eur Radiol.* 1997; 7(3): 412-4.
 63. Lemke AJ, Benndorf G, Liebig T, Felix R. Anomalous origin of the right vertebral artery: review of the literature and case report of right vertebral artery origin distal to the left subclavian artery. *AJNR Am J Neuroradiol.* 1999;20:1318–21.
 64. George B, Bruneau M. Vertebral artery. In: Tubbs RS, Soja MM, Loukas M, editors. *Bergman's Comprehensive Encyclopedia of Human Anatomic Variation*. Wiley-Blackwell. 2016. p. 1456. ISBN: 978-1-118-43035-4.
 65. Schwarzacher SW, Krammer EB. Complex anomalies of the human aortic arch system: unique case with

- both vertebral arteries as additional branches of the aortic arch. *Anat Rec.* 1989;225(3):246–50.
66. Shhadeh A, Sair HI, Kanamalla US. Bifid direct aortic arch origin of left vertebral artery: a unique vascular variant. *J Vasc Interv Radiol.* 2007;18(8):1051–3.
 67. Satti SR, Cerniglia CA, Koenigsberg RA. Cervical vertebral artery variations: an anatomic study. *AJNR Am J Neuroradiol.* 2007;28:976–80.
 68. Bruneau M, Cornelius JF, Marneffe V, Triffaux M, George B. Anatomical variations of the V2 segment of the vertebral artery. *Neurosurgery* 2006 Jul; 59(1 Supply 1).
 69. Chia-YingLin, Yi-ShengLiu, Ying-ChenChen, Yu-HsiangShih, Chao-ChunChang, and Ming-Tsung Chuang. Variations in the Origin and Course of the Extracranial Vertebral Artery on Multidetector Computed Tomography Angiography. *Iran J Radiol.* 2018April;15(2):e61623.
 70. Duan S, He E, Lv S, Chen L. Three-dimensional CT study on the anatomy of vertebral artery at atlantoaxial and intracranial segment. *Surg Radiol Anat.* 2010 Jan; 32(1):39-44.
 71. Cosar M., _plikçioğlu A.C., Arslan M., Bıkmaz K., Ceylan D. (2004) Orta Serebral Arter Anevrizmasıyla Beraber Vertebral Arter Fenestrasyonu. *Türk Nöroşirurji Dergisi* 3,196-199.
 72. Yılmaz E, Ilgıt E, Taner D: Primitive persistent carotid-basilar and carotid-vertebral anastomoses: A report of seven cases and review of the literature. *Clin Anat* 8:36-43, 1995.
 73. Mayer PL, Kier EL: The Ontogenetic and Phylogenetic Basis of Cerebrovascular Anomalies and Variants. *Brain Surgery.* Apuzzo MLJ. Volume I, (ed). New York: Churschill Livingstone, 1993: 747-754.
 74. Cho D, Kim B, Jang J et al. Cerebellar Artery Arising from the Cavernous Segment of the Internal Carotid Artery and Persistent Trigeminal Artery: A Spectrum of Incomplete Longitudinal Fusion. *Acta Radiol.* 2020;61(3):386-94. doi:10.1177/0284185119861310 – Pubmed.
 75. Goyal M. The tau sign. (2001) *Radiology.* 220 (3): 618-9. doi:10.1148/radiol.2202991498 - Pubmed
 76. Osborn GA: Diagnostic cerebral anjiography. 2nd ed. Philadelphia. Lippincott Williams & Wilkins, 1999:65-70 Caldenmeyer KS, Carrico JB, Mathews VP: The radiology and embryology of arteries of the head and neck. *AJR* 170:197-203, 1998.
 77. Luh GY, Dean BL, Tomsick TA, Wallace RC: The persistent fetal carotid-vertebrobasilar anastomoses. *AJR* 172:1427-1432, 1999.
 78. Kolbinger R, Walter H, et al: Right proatlantal artery type 1, right internal carotid occlusion, and left internal carotid stenosis: Case report and review of the literature. *J Neurol Sci* 117: 232-239, 1993
 79. Özgür Oktay, Ömer Kitiş, İsmail Oran, Ahmet Memiş: Persistan fetal karotid-vertebrobaziler anastomozlar. *Türk Tanısal ve Girişimsel Radyoloji Derg* 9(3): 382-387, 2003