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CASE REPORT

Bronchial Artery Arising from the Left Vertebral Artery: Case Report and Review of the Literature

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ABSTRACT

Knowledge of bronchial artery anatomy, including the possible locations of anomalous origin, is essential for complete catheter directed embolization for massive hemoptysis. Undetected anomalous bronchial arteries can be a source of failed bronchial artery embolization. We report a case of a common trunk bronchial artery arising from the left vertebral artery and review standard and variant bronchial artery anatomy.

Key words: Anomalous, aberrant, bronchial artery, CT angiography, embolization

INTRODUCTION

The bronchial arterial circulation is the source of bleeding in nearly 90% of cases of massive hemoptysis.[1] Bronchial artery embolization (BAE) has become an established procedure for the treatment of massive hemoptysis with proven efficacy and safety.[1] A thorough knowledge of bronchial artery anatomy, including the possible locations of anomalous origin, is an integral component of a successful procedure. The anatomy of the bronchial arteries has been previously reported in considerable detail, outlining variations in origin, course, and branching pattern.[2] We report a case of a common trunk bronchial artery arising from the left vertebral artery and review standard and variant bronchial artery anatomy relevant to complete evaluation of the bronchial arterial supply.

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CASE REPORT

An 89-year-old female with a past medical history of hypertension and chronic obstructive pulmonary disease presented to the emergency department with new onset of dizziness and gait instability that had been progressive over the prior 7 months. She was admitted

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to the Neurology service, and during her evaluation for these complaints, she developed symptoms of shortness of breath, tachycardia, and chest fullness. Computed tomographic pulmonary angiography (CTA) was performed for evaluation of pulmonary embolism using a 16-detector scanner (Lightspeed 16, GE Medical Systems, Milwaukee, WI). Images through the thorax were acquired at 1.25 mm collimation (120 kVp, 441 mA, pitch 1.375:1, rotation time 0.8s) after bolus tracking at the main pulmonary artery during the administration of 100 mL of iopamidol nonionic contrast media (Isovue 370, Bracco Diagnostics Inc.) at 5 mL/s. While pulmonary embolism was not present, incidental finding was made of an anomalous bronchial artery arising from the proximal aspect of a left vertebral artery originating from the aortic arch between the left common carotid and left subclavian arteries [Figures 1 a-c]. This single bronchial artery arose from the right posterior aspect of the left vertebral artery approximately 1.5 cm distal to the aortic arch. The bronchial artery coursed along the left aspect of the trachea prior to bifurcating into right and left bronchial arteries approximately 1 cm above the carina. Single bronchial arteries then coursed along the bilateral mainstem bronchi until subdividing into smaller tributary branches distally. No additional bronchial arteries were identified despite meticulous review of the source axial, reconstructed multiplanar, and 3D volume rendered images [Figure 2a-c].

Secondary to this finding the possibility of steal phenomena was explored via transcranial Doppler evaluation, which was negative. An etiology for the patient's neurological symptoms was not identified and the patient was discharged and advised outpatient physical and occupational therapy.

DISCUSSION

Numerous earlier investigations have evaluated the anatomy of the bronchial arteries describing variation in their origin, branching patterns and course. The bronchial arteries most commonly arise from the descending thoracic aorta between the lower margin of the T4 vertebral body and the upper margin of the T6 vertebral body (70 – 83.3%).[3] Bronchial arteries with an origin outside of this region are considered anomalous. The reported incidence of anomalous bronchial arteries varies widely,

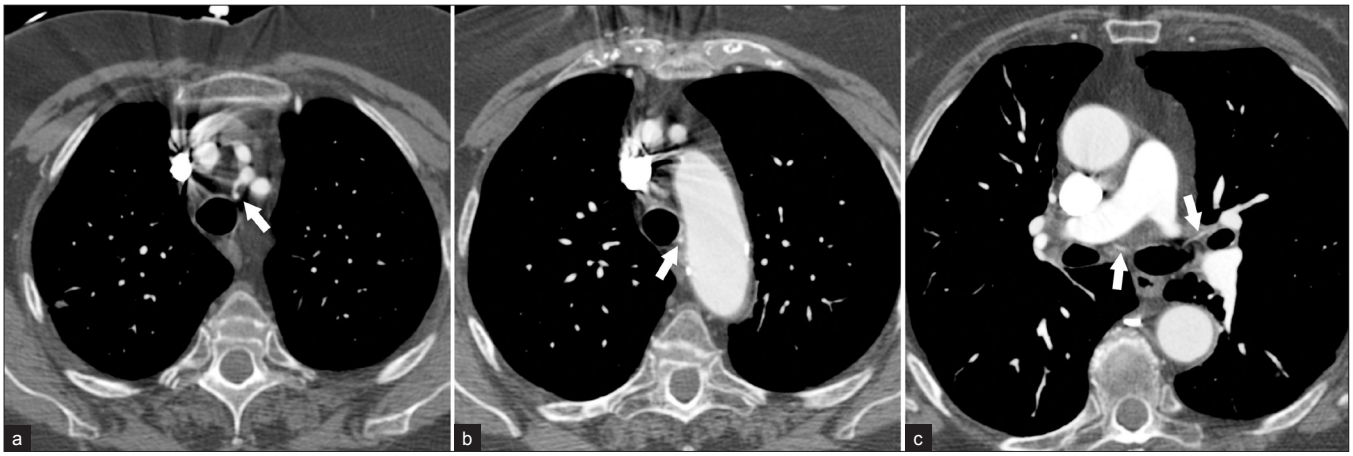

Figure 1: Contrast-enhanced axial CT images of the chest. (a) A common trunk anomalous bronchial artery arises from the left vertebral artery. (b) This bronchial artery courses inferiorly along the trachea. (c) Bifurcation of the bronchial artery into left and right branches, which supply the respective lungs.

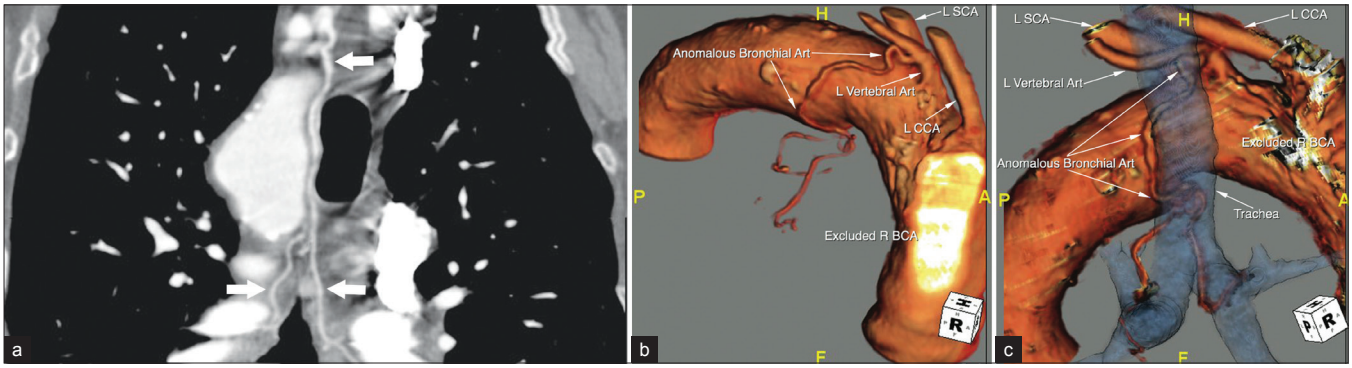

Figure 2: (a) Curved multiplanar reconstruction demonstrates the course of the bronchial artery within the mediastinum. (b) 3D volume rendered image demonstrates origin of the bronchial artery from the left vertebral artery (The right brachiocephalic artery has been excluded). (c) Note the close approximation of the bronchial artery with the adjacent tracheobronchial tree. [LSCA: Left subclavian artery; LCCA: Left common carotid artery; L Vertebral Art: left vertebral artery; RBCA: Right brachiocephalic artery]

ranging from 8.3 to 35%.[1] In 1948, Caudwell et al reported their anatomical findings after dissection of 150 human cadavers.[2] This landmark study revealed 25 anomalous bronchial arteries (16.7%), 22 arising directly from the aortic arch (14.7%), 1 from the right subclavian artery, and 2 from the left subclavian artery. A review of the literature demonstrates general agreement with these initial findings, with an anomalous origin from the aortic arch being most common and an origin from the subclavian arteries second most common. Since Caudwell et al's initial extensive study, anomalous bronchial arteries have also been reported to arise from the thyrocervical trunk, internal mammary artery, costocervical trunk, lateral thoracic artery, and the inferior aspect of the descending thoracic aorta.[3-9] Additionally, Battal et al recently described the origin of an anomalous bronchial artery from the right coronary artery via multidetector computed tomography (MDCT) [Table 1].[10]

MDCT angiography is a proven method for the evaluation of the bronchial arteries. In their retrospective study comparing conventional angiography with thin-section MDCT angiography, Remy-Jardin et al found concordant identification of the number and origin of bronchial arteries in 86% of cases.[8] Use of MDCT angiography prior to attempted BAE may provide assistance in directing selective catheterization, particularly in the setting of an anomalous origin of the bronchial arteries, possibly reducing procedure time. Further, MDCT has the added benefit of providing an opportunity to identify non-bronchial artery bleeding sources such as non-bronchial systemic arteries, bronchiectasis, bronchogenic carcinomas, and aspergillomas.[1] The normal adult bronchial arteries measure less than 1.5 mm in diameter at their origin and 0.5 mm at their point of entry into a bronchopulmonary segment.[11] Abnormal or hypertrophic bronchial arteries measure greater than 2 mm in diameter on MDCT.

We believe that this case represented a true bronchial artery, rather than a non-bronchial systemic collateral artery for several reasons. First, the 1-mm vessel diameter is well within the normal range for a native bronchial artery. Second, there was no evidence of pleural thickening, significant pulmonary disease, or associated systemic collateralization to suggest that this vessel had arisen secondary to an underlying pathologic process. Third, the patient had no prior history of bronchial artery embolization that would have lead to the recruitment of

Table 1: Reported anomalous bronchial arteries

Author	Modality	Number of anomalous bronchial arteries	Origin(s)
Cauldwell et al[2]	Cadaveric dissection	25	22 (14.7%) aortic arch; 1 R subclavian artery; 2 L subclavian artery
O'Rahilly et al[12]	Cadaveric dissection	1	Left subclavian artery
Liebow et al[9]	Cadaveric dissection	16	All from aortic arch
Ishihara et al[13]	Angiography	2	Internal thoracic artery; Intercostal diaphragmatic artery
Kasai et al[14]	Cadaveric dissection	Many	Bilateral subclavian arteries and branches (internal thoracic, thyrocervical); aortic arch; distal descending thoracic aorta
Moore et al[15]	Angiography	1	Right thyrocervical trunk
Rabkin et al[5]	Angiography	6	5 subclavian artery, 1 "thyroid axis"
Keller et al[16]	Angiography	29	1 R internal thoracic; 3 phrenic artery; 9 intercostal artery; 16 branches of the subclavian or axillary arteries
McPherson et al[6]	Angiography	2	1 superior aortic arch between brachiocephalic and L carotid; 1 R internal thoracic artery
Cohen et al[17]	Angiography	15	9 thyrocervical trunk; 4 internal thoracic artery; 1 costocervical trunk; 1 lower intercostal artery
Cohen et al[4]	Angiography	5	1 L thyrocervical trunk; 1 L internal thoracic artery; 2 R thyrocervical trunk; 1 R internal thoracic artery
Murayama et al[18]	CT angiography	1	Inferior descending thoracic aorta
Chang et al[19]	Angiography	4	1 R subclavian proximal to origin of internal thoracic artery; 1 R internal thoracic artery; 1 lateral thoracic; 1 directly from arch
Tanaka S et al[20]	Cadaveric dissection	1	Right subclavian artery
Sancho et al[3]	Angiography	27	24 from aortic arch; 1 L thyrocervical trunk; 1 from R subclavian artery; 1 from lower descending thoracic aorta
Barben et al[7]	Angiography	4	2 internal thoracic artery, 1 thyrocervical trunk, 1 lateral thoracic
Gypen et al[21]	Angiography	1	Left internal mammary artery
Remy-Jardin et al[8]	Angiography and CT angiography	12: 4 right (17%), 8 left (27%) (21% total)	Right: concavity of aortic arch (n = 2), right subclavian (n = 2); Left: concavity of aortic arch (n = 6), lower third of aorta (n = 2)
Kawate et al[22]	Angiography	1	Left subclavian artery
Battal et al[10]	CT angiography	1	Right coronary artery
Battal et al[23]	CT angiography	58	2 R subclavian artery; 2 L subclavian artery; 2 R thyrocervical trunk; 2 L thyrocervical trunk; 1 R internal mammary artery; 1 aberrant R subclavian artery; 29 from aortic arch; 19 from descending aorta either above (10) or below (9) T5/6

abnormal collateral vessels. Fourth, no additional candidate bronchial arteries were identified. Finally, and most importantly, this vessel coursed along the tracheobronchial tree, which is the main distinguishing characteristic of a bronchial artery [Figure 2c].

A complete knowledge of bronchial artery anatomy, including the locations of their common aberrant origin, is a prerequisite for successful complete angiographic assessment of the bronchial artery distribution as well as for successful embolization procedures. Failure to identify a causative bronchial artery arising from the descending aorta should prompt a search for an aberrant origin, including an evaluation of the aortic arch and of the bilateral subclavian arteries and their branch vessels. In light of the case presented here, consideration of an origin from the vertebral artery should be entertained in cases of persistent failed identification. [23]

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