

# Common Cervical and Cerebral Vascular Variants

Peter C. Thurlow, MD<sup>a</sup>, Jason M. Andrus, MD<sup>a</sup>,  
Mark H. Wholey, MD<sup>a,b,c,\*</sup>

## KEYWORDS

- Vascular variants • Carotid stenting • Aortic arch • Internal carotid artery
- Persistent carotid-vertebrobasilar anastomoses • Circle of Willis

## KEY POINTS

- Successful open and endovascular carotid artery intervention depends on a thorough foundational knowledge of cervical and intracranial vascular anatomy.
- Variant vascular anatomy is frequently observed during preprocedural evaluation and endovascular intervention.
- Alterations in the normal patterns of blood supply to the cerebral vascular territories often occur as a consequence of variant vascular anatomy.
- Recognition of cervical and intracranial vascular variants, and the corresponding changes in blood supply, is essential to successful and complication-free endovascular carotid interventions.

## INTRODUCTION

Successful open and endovascular carotid artery intervention depends on a thorough foundational knowledge of cervical and intracranial vascular anatomy. It is essential for the carotid interventionalist to be familiar with the common and rare vascular variants in the head and neck, and to understand the implications of these variants for the performance of carotid intervention with protection of the distal circulation. The purpose of this article is to provide interventionalists with a basic description of the normal and relevant variant vascular anatomy from the aortic arch to the circle of Willis, and outline the potential difficulties that specific variants may present for endovascular therapy.

## ANOMALIES OF THE AORTIC ARCH

### *Normal Anatomy*

In approximately 70% of individuals, the innominate artery, left common carotid artery (CCA),

and left subclavian arteries arise in sequence from a left-sided arch of the aorta. The innominate artery then branches into the right subclavian artery and the right CCA. The bilateral vertebral arteries arise as proximal branches of their respective subclavian artery.<sup>1</sup> A frequently used classification system for the normal aortic arch is based on the relationships of the origins of the great vessels to a tangent across the top of the aortic arch. The aortic arch is defined as type I if the origin of the innominate artery is less than 1 diameter of the left CCA from the top of the aortic arch in the vertical plane, type II if between 1 and 2 left CCA diameters, and type III if greater than 2 left CCA diameters. This classification system is designed to predict the difficulty of arch vessel intubation, and may help to guide catheter selection.<sup>2</sup> True variation of the normal aortic arch anatomy occurs frequently, and can present a challenge for catheterization. These variants are best classified according to the direction of the aortic arch (**Box 1**).

The authors have nothing to disclose.

<sup>a</sup> Department of Radiology, Allegheny General Hospital, 320 East North Avenue, Pittsburgh, PA 15212, USA;

<sup>b</sup> Center for Vascular and Neurovascular Interventions, Cardiovascular Institute, Allegheny General Hospital, 320 East North Avenue, Pittsburgh, PA 15212, USA; <sup>c</sup> Department of Biomedical Engineering, Carnegie Mellon University, Pittsburgh, PA 15213, USA

\* Corresponding author. Center for Vascular and Neurovascular Interventions, Cardiovascular Institute, Allegheny General Hospital, 320 East North Avenue, Pittsburgh, PA 15212.

E-mail address: [mwholey@wpahs.org](mailto:mwholey@wpahs.org)

Intervent Cardiol Clin 3 (2014) 123–134

<http://dx.doi.org/10.1016/j.iccl.2013.09.002>

2211-7458/14/\$ – see front matter © 2014 Elsevier Inc. All rights reserved.

**Box 1****Branching patterns of aortic arches****Arch Type****Left-sided aortic arch**

## Normal branching

Common origin of the right brachiocephalic trunk and left common carotid artery

Vertebral artery as a direct branch of the aorta

Aberrant right subclavian artery

Bilateral brachiocephalic trunks

Arteria thyroidea ima

**Right-sided aortic arch**

Mirror-image branching (type I)

Aberrant left subclavian artery (type II)

Isolation of the left subclavian artery (type III)

**Double aortic arch**

Cervical aortic arch

**Left-Sided Aortic Arch****Common origin of the right brachiocephalic trunk and left common carotid artery**

The second most common pattern of aortic arch branching consists of a common origin of the right brachiocephalic trunk and the left CCA, and is identified in 13% of the population.<sup>1</sup> Consequently, only 2 vessels arise directly from the aortic arch. A similar variant, in which the left CCA originates as a branch of the right brachiocephalic trunk, occurs in 9% of the population.<sup>1</sup> These variants have at times been erroneously referred to as a “bovine arch” or “bovine anatomy.”<sup>3</sup> However, the branching pattern of the aortic arch found in cattle consists of a single brachiocephalic trunk that subsequently gives rise to the bilateral subclavian arteries and a bicarotid trunk. This true bovine arch does not occur in humans.

**Vertebral artery as a direct branch of the aortic arch**

Although the aforementioned 3 branching patterns represent the vast majority of aortic arch variants, numerous less common but clinically significant anomalies have been reported. In approximately 4% of the population, the left vertebral artery arises as a direct branch of the aorta, most often as the third branch arising between the left CCA and the left subclavian artery.<sup>1</sup> Therefore, 4 vessels arise from the aortic arch.

**Aberrant right subclavian artery**

Although well known, the aberrant right subclavian artery (ARSA) arising as the last branch of the aortic arch distal to the left subclavian artery is observed in only 1% of the population.<sup>4</sup> An association has been made with Down syndrome.<sup>5</sup> Also termed *arteria lusoria*, this variant may result in dysphagia or dyspnea when the ARSA courses anterior to the trachea as it crosses the midline. This variant can also present unique technical challenges to reaching the coronary sinus or great vessels when encountered during the right transradial approach.<sup>6</sup>

**Other anomalies**

Although more than 20 anomalies associated with left-sided aortic arch branching have been reported in cadaveric or imaging studies, most anomalies are exceedingly rare. Right and left brachiocephalic trunks that give rise to right and left subclavian arteries and CCAs may occur with a frequency as high as 1% of the population. The lowest thyroid artery, or *arteria thyroidea ima*, may arise as a second branch from the aortic arch in approximately 1% of the population. Although this artery is only present in 6% of individuals, recognition of its presence is important before surgical dissection caudal to the thyroid isthmus is attempted.<sup>1</sup>

**Right-Sided Aortic Arch**

Right-sided aortic arch (RAA) is a rare anomaly (0.04%–0.1% on necropsy series) and has an association with congenital heart defects, esophageal atresia, and tracheoesophageal fistula.<sup>4,7</sup> The most common classification system divides right-sided aortic arch branching into 3 types. Type I represents RAA with mirror-image branching, whereby a left brachiocephalic trunk arises as the first branch of the aorta and gives rise to the left subclavian artery and left CCA, followed by right CCA and right subclavian arteries branching from the aortic arch. RAA with an aberrant left subclavian artery (ALSA) (type II), in which the ALSA arises as the last branch of the RAA, is the most common type of RAA. RAA with isolation of the left subclavian artery (type III) occurs when the left subclavian artery does not connect directly to the aortic arch. The left subclavian artery instead fills through collateral circulation, potentially resulting in arm ischemia or a steal phenomenon.<sup>8</sup>

**Double Aortic Arch**

The double aortic arch is a rare anomaly (<0.1%) that occurs when the bilateral fourth branchial

Download English Version:

<https://daneshyari.com/en/article/2937459>

Download Persian Version:

<https://daneshyari.com/article/2937459>

[Daneshyari.com](https://daneshyari.com)