

# RIGHT VERTEBRAL ARTERY: ANOMALOUS PREVERTEBRAL COURSE AND DISTRIBUTION

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### ABSTRACT

Vertebral artery (VA) is the largest branch of the first part of the subclavian artery and the chief source of blood supply to brainstem, cerebellum, occipital lobe of cerebrum and posterior cranial fossa. Anomalous origin, course and / or branching pattern of VA may lead to disturbance in vertebro-basilar hemodynamics, risking cerebro-vascular insufficiency. A unique case of right VA having usual origin, but anomalous course and branching pattern in its prevertebral segment is described. Moreover the right thyrocervical trunk was absent in present case and inferior thyroid artery branched off the variant VA. The ligation of such vertebral artery may cause a compromise to thyroid in addition to posterior cranial fossa blood supply. The information about its course is crucial during diagnostic investigations and surgical procedures in the head and neck region.

**Key words:** vertebral artery, inferior thyroid artery, anomalous course

## INTRODUCTION

Vertebral artery (VA), the 1<sup>st</sup> and largest branch of subclavian artery, arises from its posterolateral aspect and runs upward and medially to enter the foramen transversarium of 6<sup>th</sup> cervical vertebra<sup>1</sup>. It ascends through the succeeding foramina transversarium of upper cervical vertebrae. Leaving the foramen transversarium of atlas, it ascends, cranially through foramen magnum to reach the brainstem to join its fellow to form the basilar artery at ponto-medullary junction. The first segment of vertebral artery from its origin from subclavian artery (SA) to entry into respective foramen transversarium is called prevertebral segment, which is frequently affected by atherosclerosis<sup>2</sup>. The prevertebral segment of VA is followed by the vertebral and intracranial segments. VA may enter any of the foramen transversarium of 6<sup>th</sup> cervical (87.5%), 5<sup>th</sup> cervical (6.6%), 4<sup>th</sup> cervical (0.5%) and 7<sup>th</sup> cervical (5.4%)<sup>3</sup>.

Prevalence of anomalous vertebral arteries has been investigated by many researchers<sup>4,5</sup>. Although ectopic

origin of VA is uncommon, two variants have been frequently reported origin of left vertebral artery from the arch of aorta and right vertebral artery from right common carotid artery<sup>4</sup>. Although the incidence of anomalous origin of VA is relatively more than its anomalous tortuous course, failure to recognize a medially located vertebral artery may result in life threatening iatrogenic injury during spinal decompression<sup>6</sup>. Laceration of VA is the most challenging surgical dilemma during anterior cervical spinal surgery. Massive hemorrhage from ruptured VA might lead to uncertain neurological morbidity<sup>7</sup>. Therefore preoperative recognition and appropriate modification of anterior decompression of spine can yield excellent clinical results without risking significant complications. During imaging studies, surgery or cadaveric dissection in anatomy laboratory, the detection of anomalous VA is usually an incidental finding. Although most cases are clinically asymptomatic, they can initiate thrombo-embolic phenomenon, risking cerebral ischemia<sup>8</sup>.

The present case report represents a unique case of right VA with anomalous course and branching pattern in its prevertebral segment, detected by cadaveric dissection.

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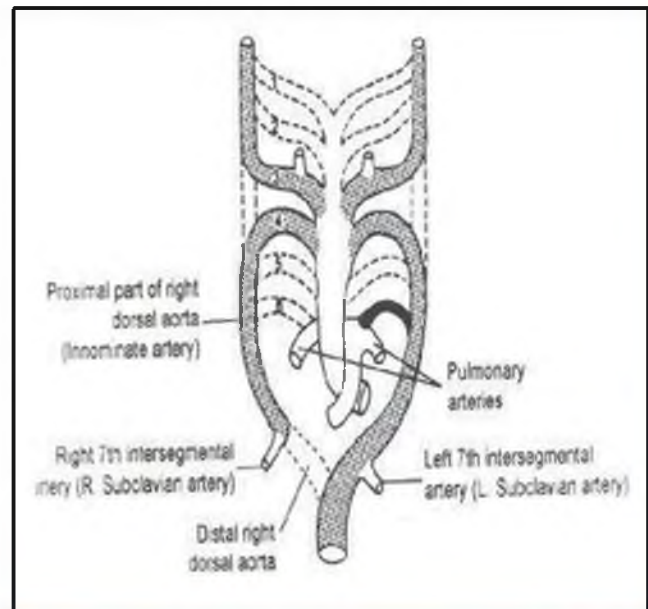
## CASE REPORT

Forty eight bodies of different ethnic origin were dissected in the laboratories of Human Anatomy, Shifa College of Medicine, Islamabad, Sir Syed College of Medical Sciences for Girls, Karachi, and College of Medicine, King Saud University, Riyadh, KSA from January, 2005 through August, 2007. There was a single case of unilateral anomalous right vertebral artery in a 55-year Caucasian male. The anomalous right vertebral artery had usual origin from superior aspect of the first part of right subclavian, with an external diameter of 8 mm at its origin, ascending vertically upward (with slight lateral inclination) between longus colli and scalenus anterior muscles to the level of superior border of thyroid cartilage (the level of bifurcation of right common carotid artery) where it turned posteriorly and entered into the foramen transversarium of 4th cervical vertebra. The prevertebral segment of anomalous right vertebral artery (ARVA) was not tortuous, however it gave origin to right inferior thyroid artery (about 2.5 cm distal to its origin from subclavian artery) which proceeded medially to reach the inferior pole of right lobe of thyroid gland. This anomalous right inferior thyroid artery was also very tortuous and was clamped between two terminal divisions / branches of right recurrent laryngeal nerve, close to inferior pole of thyroid gland (Fig.1). The thyrocervical trunk was missing in right subclavian artery (Fig 1-3).

The rest of the human body had a normal anatomy.



**Figure 1:**  
The anomalous right vertebral artery giving origin to inferior thyroid artery.

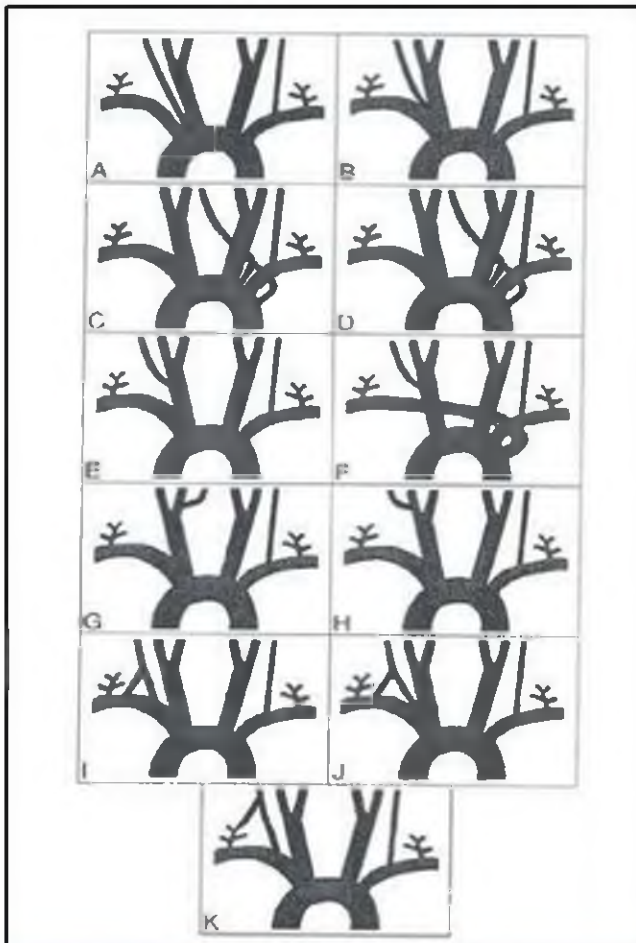


**Fig. 2.** Schematic representation of normal embryological development of great vessels. Numbers identify the aortic arch components and dotted lines represent the vessel involution. Note the persistence of the proximal right dorsal aorta with involution of its distal segment.

## DISCUSSION

To understand the anomalous development of VA, knowledge of embryological transformation of aortic arches into adult arterial system is essential. Embryologically, right subclavian artery develops from right 4<sup>th</sup> aortic arch, proximal right dorsal aorta and right 7<sup>th</sup> intersegmental artery<sup>9</sup> (Fig. 2). Usually the 1<sup>st</sup> part of right VA develops from proximal part of dorsal branch of 7<sup>th</sup> cervical intersegmental artery proximal to postcostal anastomosis. The vertebral part of vertebral arteries develops from postcostal longitudinal anastomosis between 1<sup>st</sup> to 7<sup>th</sup> cervical intersegmental arteries and the cervical intercostals obliteration zone<sup>10</sup>. During this process, the caudal part of the dorsal aorta is obliterated just before its confluence with the left dorsal aorta, and the 7<sup>th</sup> intersegmental artery continues as right subclavian artery<sup>10</sup>. Lemke et al schematically depicted different variants of ARVA cited in published scientific literature<sup>5</sup> (Fig 3).

In most cases published in the medical literature, anomalous vertebral artery did not result in clinical symptoms<sup>11</sup>. Rarely, patients complain of dizziness, having no correlation to the anomalous origin of the vertebral artery. Anomalous origin and distribution of VA



**Figure 3: Lakme's representation of variants of subclavian artery (published with permission from American Journal of Neuro radiology)**

- A.** Right vertebral artery for the aorta between the right subclavian and common carotid artery in cases of missing brachiocephalic arteries. One case has been described in the literature.
- B.** Right vertebral artery directly from the brachiocephalic artery. Three cases have been described in the literature.
- C.** Right vertebral artery from the aorta on the left between the left common carotid artery and left subclavian artery. One case has been described in the literature.
- D.** Right vertebral artery from the aorta on the left, distal to the left subclavian artery. Seven cases have been described in the literature.
- E.** Right vertebral artery from the right common carotid artery without Artery lusoria. Six cases have been reported in the literature.
- F.** Right vertebral artery from the right common carotid artery with Artery lusoria. Ten cases have been reported in the literature.
- G.** Right vertebral artery from the right internal carotid artery via the hypoglossal artery. One case has been reported in the literature.
- H.** Right vertebral artery from the right external carotid artery. There have been no known cases of this vertebral artery origin.
- I.** Right vertebral artery with double origin from the right subclavian artery. Eleven cases have been reported.
- J.** Right vertebral artery with double origin from the right subclavian artery and the brachiocephalic artery. One case has been reported in the literature.
- K.** Right vertebral artery with double origin from the right subclavian artery and the right thyrocervical trunk. One case has been reported in the literature.

can exhibit cerebral insufficiency due to changes in vertebro-basilar hemodynamics, however, there is no conclusive evidence that these variants lead to a predisposition to cerebrovascular accidents<sup>11</sup>. Anomalous VA may be an independent risk factor for arterial dissection<sup>12</sup>. The true value of detecting anomalous variants is the diagnostic gain prior to the surgery of supraaortic arteries. In present case right thyrocervical trunk was absent and inferior thyroid artery branched off the right VA, which is a unique finding. For anomalous inferior thyroid artery originating from the vertebral artery, ligation of the vertebral artery may cause compromised supply to thyroid in addition to compromised blood supply to posterior cranial fossa. Existing literature and the present study reflects the scarcity of anomalous VA in Asians (0.02%) as compared to Caucasians (2.4 – 5.8%). Detailed knowledge of an anomalous origin and distribution of supra-aortic arteries is of importance for patients who have to undergo digital subtraction angiography (as an emergency procedure) to rule out the possibility of intracranial aneurysm after subarachnoid hemorrhage.

In summary, although anomalous vertebral artery is an anatomic variant, detailed information is crucial during diagnostic investigations and surgical procedures (especially vascular surgery) in the head and neck region.

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