

Case Report

Occipital artery arising from the superior aspect of the carotid bifurcation identified by three-dimensional computed tomography angiography

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ABSTRACT

Variation of the branches of the external carotid artery is well known, but it is extremely rare for the occipital artery (OA) to arise from the carotid bifurcation (CB). A 73-year-old man was found to have this anatomical variation on the right side by three-dimensional CT angiography for vascular mapping of the carotid arteries before superselective intra-arterial catheterization. The OA arose from the CB and the inner diameter of the origin of the OA was 1.5 mm. The CB was located at the level of C3–C4 and 7.9 mm above the tip of the greater horn of the hyoid bone.

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1. Introduction

It is well known that the branches of the external carotid artery (ECA) can vary anatomically; these variations are usually asymptomatic and discovered incidentally, and occasionally a common trunk is found. Commonly, the occipital artery (OA) arises from the posterior aspect of the ECA, but it is rarely reported for the OA to arise from the internal carotid artery (ICA) or carotid bifurcation (CB).^{1,2,4,8,10} It is important to know the variations of the carotid arteries and its branches before invasive procedures to avoid complications.^{1,2,4,8,10} We report a case of the OA arising from the superior aspect of the CB identified by three-dimensional (3D) computed tomography angiography (CTA).

2. Case report

A 73-year-old man was referred to our department for treatment of right hard palate cancer. CTA was performed for vascular mapping of the carotid vessels prior to superselective intra-arterial chemoradiotherapy for organ preservation. A 64-detector spiral computed tomography (CT) scanner (Aquilion 64; Toshiba Medical, Tokyo, Japan) was used. Nonionic contrast medium (100 ml) was injected at a rate of 4.0 ml/s through an

antecubital vein with an automatic power injector. A bolus tracking technique was used to select the individual start delay for the arterial phase. Repetitive low-dose scans were performed at a level inferior to the carotid bifurcation (CB) with a delay of 8 s. The system's region of interest was placed over the common carotid artery to measure the bolus arrival time. The scanning procedure started automatically once an enhancement level of 90 Hounsfield units was reached. The scan volume included the inferior margin of the thyroid cartilage, and the bottom of C6 to the superior margin of the orbit for the arterial phase scan. The scanner settings were 120 kV, 250 mA, 64 mm × 0.5-mm slice collimation, table speed 20.5 mm/rotation (pitch 0.641), and rotation time 0.75 s. The patient was advised to hold his breath and avoid swallowing during the arterial phase scan. Image processing was done on a workstation (Ziostation; Ziosoft, Tokyo, Japan) using the volume rendering technique. Rotational images of the bilateral 3D vascular architecture were produced and viewed from different angles. Three-dimensional CTA revealed the OA arising from the superior aspect of the CB (Fig. 1). The inner diameter of the OA was 1.5 mm. The CB between C3 (third cervical vertebra) and C4 (fourth cervical vertebra) vertebra was located 7.9 mm above the greater horn of the hyoid bone and 31.5 mm above the superior margin of the thyroid cartilage (Fig. 2). On the left side, the OA originated from posterior aspect of the ECA and the CB was located at C4. Although we commonly perform superselective intra-arterial chemotherapy via the superficial temporal artery and OA, this patient underwent

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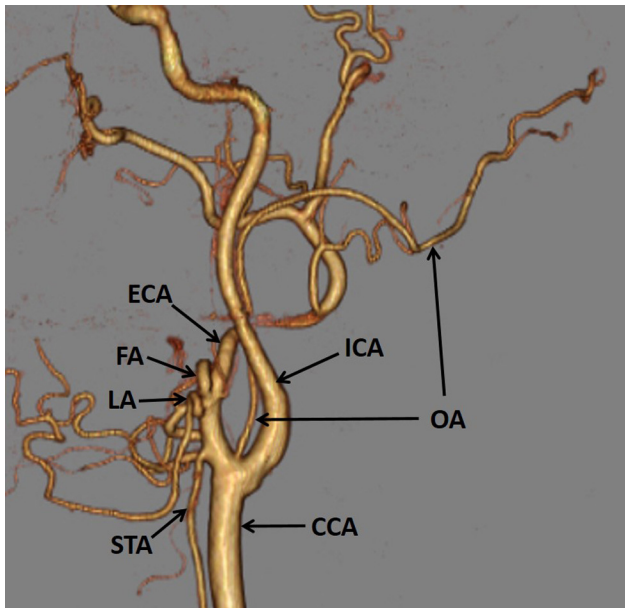


Fig. 1. Three-dimensional computed tomography angiography (3D-CTA) image of the right carotid artery. CCA, common carotid artery; ECA, external carotid artery; FA, facial artery; ICA, internal carotid artery; LA, lingual artery; OA, occipital artery; STA, superior thyroid artery.

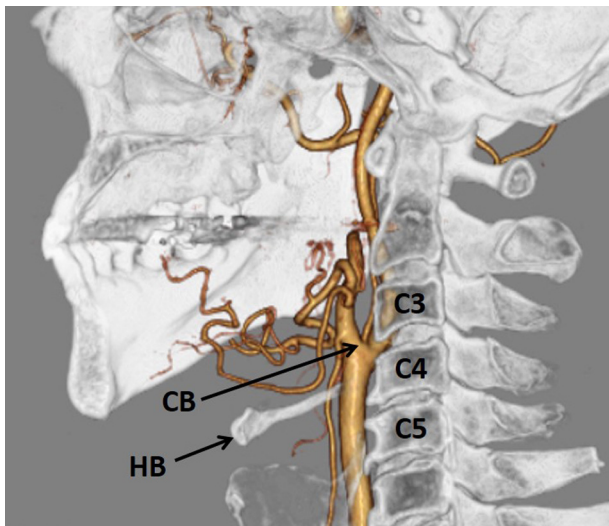


Fig. 2. Three-dimensional computed tomography angiography (3D-CTA) image of the right carotid artery and surrounding bones. CA, carotid bifurcation; C2, second cervical vertebra; C3, third cervical vertebra; C4, fourth cervical vertebra; HB, hyoid bone.

superselective intra-arterial chemotherapy via the superficial temporal artery without the OA arising from the CB to avoid cerebral infarction.

3. Discussion

The OA commonly arises from posterior aspect of the ECA and very rarely arises directly from the ICA (1). The OA arising from the CB is extremely rare,^{1,2,4,8,10} with the incidence reported to be 0.03% (1 of 2866 cases) to 1.4% (3 of 208 cases).^{8,10} In our institution, only present case had the OA arising from the CB of 926 oral cancer patients who underwent CTA for oral cancer between June 2006 and May 2016, for an incidence of 0.11%.

Anomalous originating OA occurs with right-side predominance,¹⁰ but our review of the OA arising from the CB showed there were no differences between both sides (Table 1).^{1,2,4,8,10} The ascending pharyngeal artery is sometimes the branch of the OA arising from the CB (Table 1).^{1,2} Although termination of the common carotid artery in cases with the OA arising from the CB is relatively trifurcation, Ogeng'o et al.⁸ reported a rare pentafurcation into the ECA, ICA, OA, superior thyroid artery and posterior auricular artery. Furthermore, Kishve et al.⁴ showed rarer bilateral pentafurcation into the ECA, ICA, OA, ascending pharyngeal artery and common linguofacial trunk. Generally, OA arises from the CB between the ECA and ICA,^{1,2,4,10} but Ogeng'o et al.⁸ reported a rare OA arising from the medial aspect of the CB.

The CB level commonly is at C4 vertebra or an interval between the superior border of the thyroid cartilage and inferior border of the hyoid bone.² Lemaire et al.⁶ showed that the CB was located 13.2 ± 5.6 mm below the tip of the greater horn of the hyoid bone. Trifurcation into the OA, ICA and ECA reported by Gürbüz et al.² was located above the hyoid bone and 35 mm above the superior margin of the thyroid cartilage. Kishve et al.⁴ reported the relatively high CBs were located at about 10 mm above the greater horn of the hyoid bone on both sides. In our case, the CB between C3 and C4 vertebra was located 7.9 mm above the greater horn of the hyoid bone and 31.5 mm above the superior margin of the thyroid cartilage. To our knowledge, the OA arising from the CB was commonly above the hyoid bone (Table 1).^{1,2,4}

The embryology of variant origin of the OA remains poorly understood. Lasjaunias et al.⁵ described that the OA is formed from the proatlantal artery and arises from the primitive ICA, ECA and vertebral artery at points determined by the sites of regression. Because Palmer and Philips⁹ reported a case of persistent proatlantal artery arising from the CB, the OA can arise from the CB as our patient.

Knowledge of the variations of the branches of the ECA is very important for surgical, diagnostic, and interventional radiologic procedures in the head and neck.^{4,8} Without knowledge of the patient's anatomic variations or preoperative information on the origin of branches of the ECA, the vessel may be ligated needlessly or accidental hemorrhage may be caused by the vessel injury

Table 1
Reported cases of the occipital artery arising from the carotid bifurcation.

Author ^{Ref.} (year)	Sex/age	Side	Furcation	Common trunk	CB position	Study
Gürbüz et al. ² (2001)	50/M	Left	Trifurcation	APA	Above HB	Cadaver
Chitra ¹ (2008)	55/M	Right	Trifurcation	APA	Above HB	Cadaver
Kishve et al. ⁴ (2011)	72/M	Right	Pentafurcation	–	Above HB	Cadaver
Uchino et al. ¹⁰ (2011)	32/M	Right	Trifurcation	–	NA	MRA
Ogeng'o et al. ⁸ (2014)	NA	Left	Pentafurcation	NA	NA	Cadaver
Ogeng'o et al. ⁸ (2014)	NA	Left	Pentafurcation	NA	NA	Cadaver
Ogeng'o et al. ⁸ (2014)	NA	Left	Pentafurcation	NA	NA	Cadaver
Present case	73/M	Right	Trifurcation	–	Above HB	CTA

NA, not available; M, male; F, female; CB, carotid bifurcation; HB, hyoid bone; APA, ascending pharyngeal artery; MRA, magnetic resonance angiography; CTA, computed tomography angiography.

during surgery such as neck dissection. In addition, superselective intra-arterial catheterization via the superficial temporal artery (STA) may cause cerebral infarction. If the STA is injured intra-operatively or occluded by previous intra-arterial chemotherapy, an approach via the OA is necessary to perform retrograde superselective intra-arterial chemotherapy.³ Because we generally perform superselective intra-arterial chemotherapy via the STA and OA for advanced oral cancer,⁷ the patient with the OA arising from the CB has higher risk of cerebral infarction. Therefore, it is vital that the surgical team understand radiologically the relationships between the OA, lingual artery and facial artery which is tumor feeding artery before performing superselective intra-arterial catheterization. In present case with right hard palate cancer, we performed superselective intra-arterial chemotherapy via the superficial temporal artery without the OA arising from the CB because superselective intra-arterial chemotherapy via the OA might cause cerebral infarction. In such case, we must perform not superselective intra-arterial chemotherapy via the OA arising from the CB but radical surgery, or superselective intra-arterial chemotherapy via the femoral artery or only the STA to avoid cerebral infarction during interventional radiologic procedures. To avoid cerebral infarction during interventional radiological procedures and decrease the potential for injury during surgery, we recommend the use of 3D-CTA, which carries no risk of cerebral infarction compared with digital subtraction angiography, to assess precisely 3D patterns and courses of the branches of the ECA.

Ethical approval and informed consent

Ethical approval was not required. Informed consent was obtained from the patient for being included in the study.

Conflict of interest

The authors have none to declare.

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