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Clinical Study

The glomic artery supply of carotid body tumors and implications for embolization

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ABSTRACT

Carotid body tumors (CBT) are rare neuroendocrine neoplasms that usually present in the third or fourth decades of life and are benign in more than 95% of cases. In the angiographic literature, the arterial supply to carotid body tumors is well documented but is often incomplete, with infrequent mention of the glomic artery, a common arterial feeder described in the anatomic and pathologic literature. Through a review of our neuroendovascular patient database, we identified eight patients with CBT undergoing transarterial embolization followed by resection. Mean patient age was 51.5 years (range 29–82), and all patients were female. Mean tumor size was 91.2 cc (standard deviation [SD] 61.1, median 67.7 cc). After embolization, greater than 90% flow reduction was achieved in 5/8 patients (63%); 60–80% flow reduction was achieved in the remaining patients. Mean operative blood loss was 166 cc (SD 100, median 122 cc) and mean operative time was 252 minutes (SD 134.5, median 155 minutes). Pre-embolization angiography was reviewed to identify a glomic artery, defined as a dominant artery supplying the CBT arising from the region of the carotid bifurcation. In six of eight patients (75%) a glomic artery could be identified, arising from the common carotid artery in 4/6 patients and the external carotid artery in 2/6 patients. Thus, glomic artery to supply to CBT was identified in the majority of patients in this series. Knowledge of its presence and identification as a direct supplier, frequently from the common carotid artery itself, provides an avenue for more thorough preoperative embolization of CBT.

1. Introduction

Carotid body tumors (CBT) are rare neuroendocrine neoplasms that present in the third or fourth decade of life and are benign in more than 95% of cases [1–3]. Because treatment is typically accomplished by transarterial embolization followed by surgical resection, a working knowledge of the vascular anatomy is critical to safely perform embolization.

The carotid body develops from the third branchial arch and contains homeostatic chemoreceptor cells which detect changes in arterial blood gases, pH, and temperature and stimulate appropriate changes in respiratory rate, tidal volume, heart rate, contractility, vasoconstrictor tone, and cerebral cortical activity [4]. The carotid body is a highly vascular structure measuring on average 7 mm × 4 mm × 2 mm; it is usually situated in the adventitia of the posteromedial aspect of the carotid bifurcation. Its location, however, is variable and the gland may sometime be bilobed [5].

In the angiographic literature, the arterial supply to CBT is well documented but incomplete, with only rare mentions of the glomic artery, which is commonly described in anatomic and pathologic literature, where the arterial supply of the carotid body is said to arise via the glomic artery from the bifurcation itself or from the wall of either the internal carotid artery (ICA) or external carotid artery (ECA). It travels on average 2 mm postero-superiorly within the ligament of Mayer to the inferior surface of the gland [6–8]. In this paper, through a review of our neuroendovascular experience with CBT, we illustrate the prevalence and angiographic location of the glomic artery.

2. Methods

We performed a retrospective review of our neuroendovascular patient database from January 2007 through April 2013 for patients with CBT undergoing transarterial embolization followed

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Table 1
Summary of patient demographics, tumor characteristics, embolization, and surgical results

Patient	1	2	3	4	5	6	7	8
Age, years	29	56	72	82	45	39	46	43
Sex	F	F	F	F	F	F	F	F
Dimensions, mL	75.4	25.1	16.3	106.0	146.9	25.8	182.9	60
Glomic artery supply	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Embolic agent	ES, coils	ES, coils	Coils	PVA, coils	Coils	Coils	ES, coils	Onyx[a], coils
Flow reduction %	70	>90	60	>90	>99	>90	80	>90
Duration, minutes	131	138	96	120	65	405	392	420
Blood loss, mL	200	100	50	100	10	200	100	400

[a] ev3 Endovascular, Plymouth, MN, USA.
ES = Embospheres (Merit Medical Systems, Salt Lake City, UT, USA), F = female, PVA = polyvinyl alcohol.

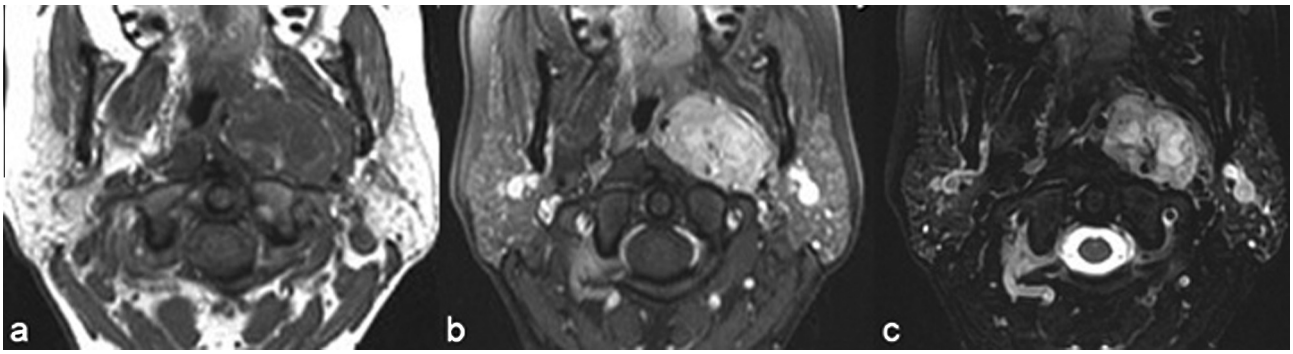

Fig. 1. Axial T1-weighted (a), T1-weighted post-contrast (b), and T2-weighted MRI with fat saturation (c) of a representative left carotid body tumor showing a salt-and-pepper appearance with avid arterial enhancement.

Fig. 2. A pre-embolization common carotid artery injection demonstrates a hypervascular pathologic mass corresponding to the carotid body tumor (a). Radiograph demonstrates the Onyx cast after Onyx embolization (ev3 Endovascular, Plymouth, MN, USA) (b), and post-embolization control common carotid artery angiogram demonstrates dramatic flow reduction to the lesion (c).

by resection. Angiographic and cross sectional images were reviewed along with the medical record in order to identify the arterial supply of the tumors, the mean tumor size, success of embolization, operative time, and operative blood loss. We determined the presence or absence of a glomic artery according to the definition of a dominant artery supplying the CBT arising from the region of the carotid bifurcation.

All procedures were performed under general anesthesia via common femoral artery access. Control angiographic runs of the common carotid artery (CCA), ICA and ECA were performed prior to and following embolization, first to delineate the arterial supply to the lesion and potential extracranial to intracranial anastomoses and at the conclusion to evaluate the angiographic result as well as potential nontarget embolization.

3. Results

We identified eight patients undergoing preoperative embolization of CBT prior to surgical resection (Table 1). A representative pre-treatment MRI is provided in Figure 1. Mean patient age was 51.5 years (range 29–82), and all patients were female. One patient had a family history of CBT. Mean tumor size was 91.2 cc (standard deviation [SD] 61.1, median 67.7 cc). The primary embolic agent was coils in seven patients and Onyx (ev3 Endovascular, Plymouth, MN, USA) in one patient (Fig. 2). Embospheres (Merit Medical Systems, Salt Lake City, UT, USA) were employed adjunctively in three patients and polyvinyl alcohol particles in one patient. Greater than 90% flow reduction was achieved in 5/8 patients (63%) and 60–80% flow reduction was