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Efficiency of preoperative embolization of carotid body tumor

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ABSTRACT

Objective: The purpose of this study is to compare the efficiency of preoperative embolization on vascular rupture rates during surgery in 13 patients within two groups.
Methods: Retrospective medical records of 7 patients who did undergo preoperative tumor embolization and 6 patients who did not undergo embolization were reviewed. All patients underwent surgical resection of a carotid body tumor from 2010 to 2014 within a tertiary care hospital. Demographic data including age, gender, and tumor size were collected. Glomic artery supply was evaluated with digital subtraction angiography in each patient. The degree of flow reduction was calculated instantly following each injection of embolic material. Complications of embolization were also collected. The estimated blood loss and the operation time were obtained from intraoperative records and operative notes dictated at the time of surgery. Operative records were evaluated for carotid artery rupture and Shamblin classification of glomus tumors.
Results: The mean patient age was 48.5 years (range 22–70), and 3 patients were male, 10 were female. All of the patients except one had Shamblin classification II. The mean diameter of tumor size was 4.42 cm. Relative rates of blood flow reduction during embolization were greater than 50% in 4 patients and 25–50% in 3 patients. Carotid artery injury was recorded in 4 patients within embolization group and in 1 patient within the other group. There were no significant differences between carotid artery rupture and embolization, blood loss, tumor size, and supplying artery.
Conclusion: Transarterial preoperative embolization of carotid body tumor does not seem to be helpful and should be discussed.

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 [1,2]. They are called by a variety of names, including chemodectoma, glomus caroticum, and carotid body paraganglioma. The arterial supply to CBT, which is predictable via angiography, is said to arise via glomic artery from the bifurcation, internal carotid artery, and mainly from the external carotid artery. Although carotid body tumors usually present as slow-growing vascular mass, it is suggested that the excision should be performed as soon as possible because of the malign transformation.

Management of the carotid body tumors' treatment is controversial. Although surgery is the only curative treatment for carotid body tumors, radiotherapy may be used alternatively, in such cases of giant or unresectable and recurrent carotid body tumors or in malignant tumors with metastases to the regional lymph nodes. Especially, regarding the role of preoperative selective angiography with embolization of CBTs has been debated since the first successful report of carotid body tumor embolization was published in 1983 by Shick et al. [3]. It is known that the indications of angiography with embolization performed less than 48 h before surgery include a reduction in tumor size, which reduces blood loss, operating time, and that also facilitates the surgical dissection. However, other authors have declared that although blood loss may be reduced after preoperative embolization, transfusion requirements are not affected, and the embolization procedure adds a significant risk for stroke [4–7] and it could increase vascular rupture rate concerning the vascular structure.

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In this study, we compared vascular rupture rate during the surgery between two groups: one group who underwent surgical excision of CBTs without embolization and the other group who underwent surgical excision of CBTs after embolization.

2. Materials and methods

The medical records of all patients with a diagnosis of CBT who underwent surgical resection by the senior author (M.K.) from 2010 to 2014 were reviewed retrospectively. All patients were treated at a tertiary care hospital. Patient charts were reviewed for demographic data including age, sex, and tumor size. In all cases, radiography including computed tomography, ultrasonography, and/or magnetic resonance imaging was used to delineate the CBT, but the diagnosis was confirmed with standard angiography and magnetic resonance angiography. The estimated blood loss (EBL) and the operation time were obtained from intraoperative records and operative notes dictated at the time of surgery. There was one case of incidental synchronous contralateral CBTs identified during the workup.

Patient selection was done for embolization on the time of patient presentation. All of the patients had undergone angiography to confirm the diagnosis of the glomus caroticum and to identify the arterial supply of the tumors by standard transcutaneous femoral catheterization. We identified 7 patients who approved all the complications of embolization, undergoing preoperative embolization of CBT prior to surgical resection. Polyvinylalcohol (PVA) was used as the embolization material in all patients. Balloon occlusion testing (BTO) was not routinely performed during the procedure. All surgeries in embolization groups were performed within 24–48 h.

Five patients, who did not consent, underwent surgical excision without embolization. Surgical excision was performed via a standard cervical approach with proximal and distal control of the common, internal, and external carotid arteries, as well as the jugular vessels. Surgical specimens were evaluated by a senior pathologist. Colleagues from the cardiovascular surgery team were always on standby for possible bypass procedures.

Statistical analysis was performed with a 2-sample independent Student's *t*-test. Results were considered statistically significant with p values of less than 0.05.

2.1. Evaluation of carotid body tumors

Shamblin's classification is commonly used to stage carotid body tumors and though this is based on intraoperative findings, it can be applied to radiologic findings prior to treatment. Three different types of carotid body tumors are described. Type I consists of a small tumor with minimal attachment to the carotid vessels. Type II tumors are larger and more adherent and moderate attachment to carotid vessels, but resectable with preservation of the carotid vessels. Type III tumors are large and completely surround the carotid bifurcation which require arterial sacrifice with reconstruction [8].

3. Results

Between 2010 and 2014, a series of 13 patients with CBTs were managed with surgical removal with or without embolization. Three patients were male (23%), and 10 were female (77%). The ages of the patients varied between 22 and 70 years (mean, 48.5 years). One of the CBTs was bilateral, and 5 of them were on the left side and the remaining were on the right side of the neck. None of the patients required a revision procedure after the primary tumor resection. The tumor sizes for both groups ranged from 3.0 to 7.0 cm in maximum diameter (mean, 4.42 cm). Statistical analysis did not reveal any significant differences between groups with regard to age, tumor size, and arterial supply of the tumors.

Seven patients (5 women and 2 men) with CBT were managed with surgery involving embolization (Table 1). The mean age of these 7 patients was 47.4 years (range, 22–68 years), and the mean tumor size was 4.6 cm (range, 3–7 cm). All of the patients except one had Shamblin classification II. Greater than 50% flow reduction was achieved in 4/7 patients (57%) and 25–40% flow reduction was achieved in the remaining patients. The intraoperative EBL for patients who underwent surgery with embolization varied from 120 to 1000 mL (mean, 375 mL). The mean operation time was recorded as 172 min in embolization patients (Table 3). Transient left hemiparesia, the numbness of tongue, hypertension, and localized pain were the complications during embolization. Although carotid artery injury was recorded intraoperatively in 4 embolization patients, 2 patients required cardiovascular surgery team and all were repaired with primary suture. Carotid artery reconstruction using covered stent graft was needed in one patient because of invasion and surrounding the carotid artery with 360 degree by the mass.

The presence or absence of a glomic artery was determined according to the definition of a dominant artery supplying the CBT arising from the region of the carotid bifurcation. Mainly, external carotid artery (ECA) supply was seen in both groups, supply was also seen from the internal carotid artery (ICA) in one patient. The difference in glomic artery between the groups was not statistically significant ($p = 0.45$; non-significant).

Six patients (5 women and 1 man) with CBT were managed with surgical excision alone (Table 2). The mean age of these 6 patients was 49.8 years (range, 22–70 years), and the mean tumor size was 4.1 cm (range, 3–6.5 cm). Shamblin classification II

Table 1
Who did undergo preoperative tumor embolization.

Patient	1	2	3	4**	5	6	7
Age, years	68	65	61	22	41	53	22
Sex	F	F	M	F	F	F	M
Dimensions, cm	4 × 4 × 2	5 × 4 × 2.5	7 × 3 × 2	3.5 × 3 × 2.5	6 × 4.5 × 3	2 × 2 × 3	4 × 3 × 2
Glomic artery supply	ECA	ECA	ICA	Multiple	Multiple	ECA	ECA
Flow reduction, %	50	70	30	75	25	40	80
Complication of embolization	Hemiparesis of tongue	–	Hypertension	–	–	Localized pain	Tongue necrosis
Carotid artery rupture	+	–	+*	+	–	+	–
Classification	Type 2	Type 2	Type 3	Type 2	Type 2	Type 2	Type 2
Blood loss, mL	350	150	1000	380	180	450	120
Operation time, min	180	150	210	180	170	160	160

ECA, external carotid artery; ICA, internal carotid artery; F, female; M, male.
* Carotid artery reconstruction using covered stent graft needed in one patient.
** Bilateral glomus caroticum tumor in one patient.