Carotid body tumor resection utilizing a covered stent graft to enable resection of the tumor en bloc with the internal carotid artery

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ABSTRACT

Surgical excision is the primary treatment for carotid body tumors (CBT) and infrequently involves carotid vessels reconstruction. A CBT that extends distally to the level of the skull base makes surgical reconstruction very challenging. We report a case of a 30-year-old man who presented with a CBT (Shamblin III) extending to the base of the skull. A covered stent graft was placed in the internal carotid artery. Subsequently, a successful resection of the tumor with the arterial wall en bloc was performed, leaving the stent graft exposed as a bridge between the two ends of ICA. (J Vasc Surg Cases and Innovative Techniques 2019;5:481-4.)

CASE REPORT

A 30-year-old man with a history of seizure disorder presented with a progressively growing, painless, and pulsatile mass in left neck of 6 months duration. The patient was asymptomatic and had no constitutional symptoms of fever, chills, or malaise, and no evidence of hoarseness. He also denied any personal or family history of paragangliomas. On physical examination, a 5-cm pulsatile and nontender mass was present in the left anterolateral neck. Contralateral neck examination was normal. No cranial nerve deficits were identified and nasal laryngoscopy demonstrated normal vocal cord mobility. He underwent a series of radiologic studies including a computed tomography angiogram that showed a 4.6- × 6.3-cm mass encasing the common carotid artery (CCA), internal carotid artery (ICA), external carotid artery (ECA) and splaying the carotid bifurcation with luminal narrowing of ICA (Fig 1). The mass was found to extend superiorly to the level of the skull base. There was no contralateral tumor. He also underwent an octreotide scan and a 24-hour urine metanephrine collection. The results of these tests were consistent with a nonfunctional carotid body tumor (CBT). Based on the presentation and imaging, the patient was diagnosed with a CBT (Shamblin class III) extending from the carotid bifurcation to the base of the skull.

Based on the extent of the tumor, a multidisciplinary team (ENT, vascular surgery, and neurointerventional radiology) was assembled to plan and execute the CBT resection. The decision was made to proceed with the balloon occlusion test and a first-stage embolization of the ECA. Both of these procedures were performed in the same setting. The balloon occlusion test was performed because of the team's concern that, with the distal tumor extending to the skull base, if a shunt were needed during reconstruction of the ICA, it would not be technically possible. On balloon occlusion testing, the patient immediately developed contralateral upper extremity paresthesias and weakness. For the embolization, a microcatheter was used to select branches of the ECA that were directly feeding the tumor. These were successfully coil embolized using 2 mm × 3 cm Axium coils (ev3, Irvine, Calif). However, there remained multiple smaller branches that were not able to be selectively cannulated. A 6 mm × 10 mm Amplatzer plug was deployed at the ECA trunk for total vessel occlusion. Owing to the positive balloon occlusion test, the decision was made to preserve the vessel and proceed with placement of a covered stent graft the following day extending from the left CCA to the left ICA just above the skull base. We used a standard Seldinger technique to gain access in the left common femoral artery and a 9F femoral sheath was placed. With the combination of a 5F Bernstein catheter and a 0.035" guidewire, the left CCA/ICA was selected. A 6F shuttle guide catheter was then advanced and positioned 2 cm proximal to the left carotid bifurcation. The Berenstein catheter was then exchanged for a stiff guidewire. Over this wire, a 9 mm × 10 cm Gore Viabahn (W. L. Gore & Associates, Flagstaff, Ariz) stent graft was deployed. After deployment, the diagnostic catheter was then advanced into the left CCA for follow-up angiograms of the neck and of the brain. Given the absence of atherosclerotic plaque, an embolic protection device was not used. The plan was for the stent graft to serve as a conduit to provide uninterrupted blood flow to the distal ICA during resection of the CBT and ICA wall. The patient was kept on aspirin for the stent graft.

The patient tolerated the first stage well and was then brought to the operating room 48 hours later for second stage surgical resection. As a precautionary measure, intraoperative

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Fig 1. Axial computed tomography angiography showing an avidly enhancing mass encasing and splaying the internal carotid artery (ICA) and external carotid artery (ECA).

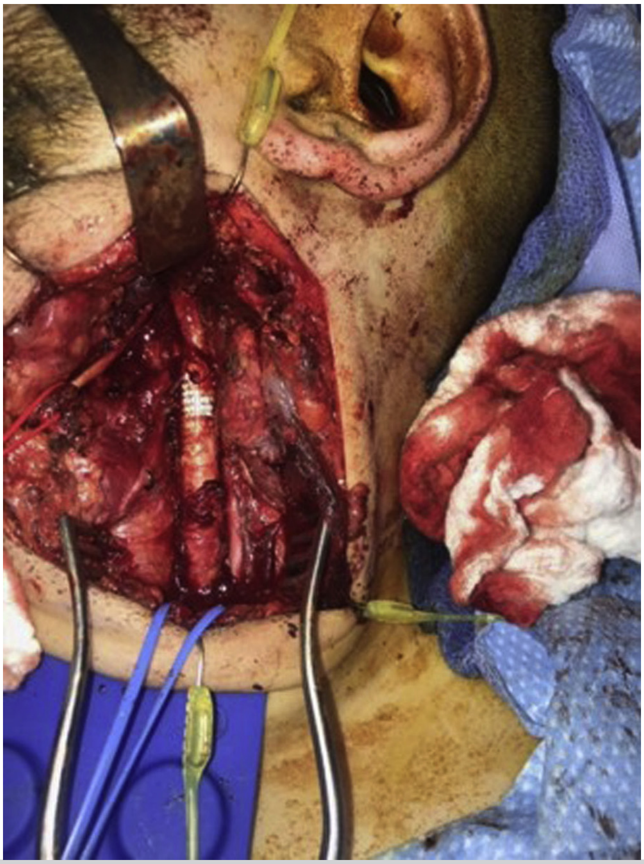

Fig 2. Intraoperative image of the common carotid artery (CCA)-internal carotid artery (ICA) with a thin vascular wall and a visible stent graft.

neuromonitoring was used. A curvilinear incision was performed in the anterolateral left neck at the level of the inferior border of the submandibular gland. Subplatysmal flaps were elevated. The anterior border of the sternocleidomastoid muscle was skeletonized and retracted laterally. Proximal circumferential control of the CCA was obtained. Attention was then turned toward the distal aspect of the tumor. The hypoglossal nerve was identified and preserved. The tumor was then dissected, in an antegrade-retrograde fashion, off of the CCA using a combination of sharp dissection between ties and harmonic scalpel. The tumor was freed from the surrounding structures. The superior laryngeal nerve was encompassed by the tumor and was resected. At the level of the carotid bifurcation, the tumor was invasive into the arterial wall, which required careful resection of the entire artery wall leaving the covered stent graft visible (Fig 2). Care was taken not to dislodge the stent graft and to ensure that the stent graft was not incised. The tumor was then removed uneventfully and sent for histopathologic examination (Fig 3). There was minimal blood loss with mild postoperative dysphagia. The patient was discharged home on postoperative day 3 tolerating a regular diet. A surveillance computed tomography angiogram of the head and neck 4 weeks after the surgery demonstrated a widely patent stent graft with no evidence of residual tumor (Fig 4).

DISCUSSION

CBTs are rare neoplasms that originate from neural crest cells located at the level of carotid bifurcation and represent the most common type of neck paragangliomas.[1] Vascular surgeons are frequently involved in their management. Tumor resection is the treatment of choice and radiotherapy is reserved for recurrent tumors or patients who are poor surgical candidates. The Shamblin classification of the CBT is chiefly based on the relationship of the tumor to the carotid vessels, ICA, and ECA. A type I tumor is small and easily separated from the adjacent arterial wall. Type II lesions are larger and partially encapsulate the vessel. Type III lesions are densely adherent to and intimately surround the carotid arteries.[2] A traditional surgical approach becomes increasingly challenging as the Shamblin class increases and when the tumor encases the CCA/ICA circumferentially. In these cases, any attempt at complete resection carries a substantial risk of blood loss and cranial nerve injury. To mitigate the risk of blood loss and to aid in safer resection, preoperative ECA coil embolization has become a preferred strategy by many.[3,4] Another technique reported has involved placing a covered stent in the ECA to cover the primary feeding branches to the

Fig 3. Gross specimen of the resected carotid body tumor (CBT).

tumor.[5] Although ECA sacrifice or embolization is generally well-tolerated, ICA ligation is associated with a 25% risk of stroke.[6,7] Traditionally, in cases where carotid artery resection is required, cerebral revascularization is achieved with a GSV or prosthetic interposition graft.[8,9] However, for tumors that extend to the level of skull base, obtaining distal control is difficult, making surgical revascularization a high-risk option. This risk becomes more significant if a shunt is required owing to the additional distal ICA length that is necessary to safely secure a shunt during revascularization.

Based on the radiologic evidence of complete ICA encasement by tumor, it was clear that this patient would require resection of the ICA with the tumor. Whenever ICA resection or need for occlusion of the ICA to facilitate reconstruction is being considered, we use a balloon occlusion test. We routinely performed this test to assess the collateral circulation to aid in the decision-making process when carotid artery ligation versus reconstruction is in question. Our patient demonstrated contralateral upper extremity numbness almost immediately after balloon occlusion. At the time, his systolic blood pressure was 135 mm Hg and his diastolic blood pressure was 80 mm Hg. Given his symptoms, we suspect that he may have had insufficient intracranial collateral circulation or vasodilatory reserve to provide adequate cerebral blood flow at the time of occlusion. Unfortunately, there is no standardized way to quantify inadequate blood flow during a balloon occlusion test and the results of the test are entirely based on the clinical symptoms.

Given the preoperative positive balloon occlusion test, any carotid resection would require preservation of antegrade blood flow through the ICA. To achieve this goal during traditional surgical revascularization would require shunt placement during the reconstruction. The multidisciplinary team believed that safe placement of a shunt was not technically possible given the distal extent of the tumor to the base of the skull. Therefore, the decision was made to place a covered stent graft to serve as a bridge between the two ends of carotid artery below and above the tumor; this stent graft bridge would preserve continuous antegrade blood flow while the tumor and wall of the ICA were resected. To our knowledge, this is the first report documenting the use of a stent graft in the ICA to facilitate CBT resection en bloc with the wall of the ICA and leaving the stent graft exposed as a bridge between normal artery below and normal artery above. When using this technique, great care should be taken not to dislodge the stent. Careful attention to ensuring an adequate proximal and distal seal length is critical to mitigate this risk. We intentionally chose to use a 10-cm length stent graft to ensure that we could deploy it in normal, uninvolved, carotid artery with a minimum of 2 cm above and 2 cm below the tumor.

Fig 4. Multislice spiral computed tomography angiography with three-dimensional reconstruction at 1 month demonstrating adequate positioning of the stent.

Protective ICA stenting in the management of head and neck cancer was first reported by Nussbaum et al[10] in 2000. They reported a single case of bare metal stent placement 1 month before the planned resection of the neck malignancy involving the ICA. This allowed for a neoendothelium formation and subsequent resection of the entire arterial wall. However, the first use of preoperative ICA/CCA covered stenting was reported by Markiewicz et al[11] in a case series of five patients who subsequently underwent successful subadventitial resection of the head and neck tumors without needing revascularization. Although surgical peel, or subadventitial resection, might be sufficient in some patients, in cases with circumferential involvement or frank invasion of the ICA is present, as in our patient's case, a complete resection of the entire arterial wall is required.

CONCLUSIONS

We report a case of a 30-year-old man who presented with a CBT (Shamblin III) extending to the base of the skull. A covered stent graft was placed in the ICA preoperatively that allowed for a complete resection of the tumor with the arterial wall en bloc while maintaining an uninterrupted blood flow to the distal ICA. Surgical resection and arterial wall reconstruction with vein remains the gold standard treatment, but in cases where distal control of the vessel is not obtainable, a placement of a covered stent greatly helps in resection of the tumor. No data yet exist on the long-term patency of covered stents in the carotid system. The natural size mismatch between the CCA and the ICA often leads to significant stent oversizing in the ICA. Although purpose-built carotid artery bare metal stents are made in tapered configurations, currently, there are no tapered covered stents that are commercially available. Therefore, we deliberately chose to use a self-expanding stent graft because it has the property of self-tapering and, generally, will contour to the inner lumen of the carotid artery. Given the oversizing, long-term surveillance is imperative to evaluate for any subsequent restenosis owing to fabric infolding. This patient requires life-long surveillance duplex imaging follow-up.

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REFERENCES

1. Gad A, Sayed A, Elwan H, Fouad FM, Eldin HK, Khairy H, et al. Carotid body tumors: a review of 25 years experience in diagnosis and management of 56 tumors. Ann Vasc Dis 2014;7:292-9.
2. Shamblin WR, ReMine WH, Sheps SG, Harrison EG Jr. Carotid body tumor (chemodectoma). Clinicopathologic analysis of ninety cases. Am J Surg 1971;122:732-9.
3. Power AH, Bower TC, Kasperbauer J, Link MJ, Oderich G, Cloft H, et al. Impact of preoperative embolization on outcomes of carotid body tumor resections. J Vasc Surg 2012;56:979-89.
4. Economopoulos KP, Tzani A, Reifsnyder T. Adjunct endovascular interventions in carotid body tumors. J Vasc Surg 2016;61:1081-91.
5. Scanlon JM, Lustgarten JJ, Karr SB, Cahan JI. Successful devascularization of carotid body tumors by covered stent placement in the external carotid artery. J Vasc Surg 2008;48:1322-4.
6. Maves MD, Bruns MD, Keenan MJ. Carotid artery resection for head and neck cancer. Ann Otol Rhinol Laryngol 1992;101:778-81.
7. Konno A, Togawa K, Iizuka K. Analysis of factors affecting complications of carotid ligation. Ann Otol Rhinol Laryngol 1981;90:222-6.
8. Wright JG, Nicholson R, Schuller DE, Smead WL. Resection of the internal carotid artery and replacement with greater saphenous vein: a safe procedure for en bloc cancer resections with carotid involvement. J Vasc Surg 1996;23:775-80.
9. Miao B, Lu Y, Pan X, Liu D. Carotid artery resection and reconstruction with expanded polytetrafluoroethylene for head and neck cancer. Laryngoscope 2008;118:2135-8.
10. Nussbaum E, Levine S, Hamlar D, Madison MT. Carotid stenting and "extarterectomy" in the management of head and neck cancer involving the internal carotid artery: technical case report. Neurosurgery 2000;47:981-4.
11. Markiewicz MR, Pirgousis P, Bryant C, Cunningham JC, Dagan R, Sandhu SJ, et al. Preoperative protective endovascular covered stent placement followed by surgery for management of the cervical common and internal carotid arteries with tumor encasement. J Neurol Surg B Skull Base 2017;78:52-8.

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