Carotid resection and reconstruction associated with treatment of head and neck cancer

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Patients with head and neck cancer may experience carotid artery involvement. We present a series of 10 patients, all with stage IVB disease, who required carotid resection and reconstruction to achieve a complete resection. Nine of the 10 patients had previous radiation treatment to the neck. Six died of distant disease, and three died of other causes with no local or regional recurrences. Carotid resection and reconstruction can be done safely, achieving local and regional control.

Tumor involvement of the carotid artery is considered stage IVB disease with a grave prognosis. Kennedy reported a 7% 5-year survival, a 46% local recurrence rate if treated by methods other than resection, and a 56% to 68% rate of distant metastases (1). Interestingly, 18% of those with local recurrence die from uncontrolled disease in the neck, even in the absence of distant metastases, which is why we support an aggressive approach with stage IVB disease. Yet, resecting and reconstructing the carotid artery to obtain an R0 resection (R0 defined as no residual disease) remains a controversial issue and is dependent on the surgeon’s philosophy and skills as well as the patient’s desire and fortitude. Here we report our experience with carotid resection associated with treatment of head and neck cancer.

METHODS

To determine the outcomes of carotid resection during oncologic surgery, we conducted an institutional review board–approved retrospective chart review of patients who were treated between the years of 1995 and 2010. Data were evaluated for demographic information, type of surgery, complications, and mortality.

RESULTS

Ten patients between the years of 1995 and 2010 required carotid resection and reconstruction to obtain a complete oncologic resection (R0). The surgery was done by two head and neck surgeons at Baylor University Medical Center at Dallas along with five vascular surgeons from Baylor Heart and Vascular Hospital. As shown in Table 1, eight of the patients were men, and seven were >65 years old. All had squamous cell carcinoma with T4b lesions encasing or invading the carotid artery. Nine patients had previous neck radiation, while seven had a smoking history. Hypertension, coronary artery disease, and chronic obstructive pulmonary disease were the most common comorbidities. Eight carotid arteries were reconstructed using polytetrafluoroethylene (PTFE) graft, one using the cephalic vein, and one using the greater saphenous vein. Wound closure and vascular coverage were achieved with seven pectoralis flaps, one anterolateral thigh free flap, one radial free flap, and one primary neck closure.

Postoperative complications included osteonecrosis secondary to postoperative radiation at 5 years, stroke with hemiparesis secondary to occlusion of the PTFE graft with resolution of symptoms at 3 months, pseudoaneurysm of the PTFE graft at 23 months repaired with a greater saphenous vein interposition graft, cricopharyngeal spasms treated with serial balloon dilations and Botox injections, partial pectoralis flap loss secondary to a tracheostomy tie, neck abscess drained in the operating room, and a thigh hematoma after an anterolateral thigh free flap required drainage. None of the complications was life-threatening. All patients with complications had a history of radiation (except one patient who developed osteonecrosis secondary to postoperative radiation).

One patient is alive at 2 months with no evidence of disease (NED). Nine patients are dead; six died of distant metastases at 5, 8, 8, 13, 29, and 37 months, all with no local or regional recurrence (Table 2). The longest survivor died of vasculopathy at 138 months with NED. One died of cerebrovascular accident and esophageal cancer at 52 months with NED, and another died of necrotizing pneumonia at 4 months with NED.

DISCUSSION

Our data confirm that carotid resection and reconstruction can be performed safely when head and neck surgeons collaborate with vascular surgeons, resulting in improved survival without undue risk of stroke or death. A complete oncologic resection (R0) is achieved, and local and regional control of the disease is attained without sacrificing the patient’s quality of life.

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Preoperative assessment for advanced head and neck disease includes ultrasound, computed tomography (CT), and magnetic resonance imaging (MRI). Ultrasound may show echoes between the mass and artery to be attenuated, a flattened artery, or luminal invasion of the tumor (2). There is a substantial risk of carotid involvement when CT shows 180-degree involvement or <1.8 mm separation between the mass and carotid (3). MRI has a sensitivity of 100% and a specificity of 88% in suggesting unresectability when >270 degrees of circumferential involvement is seen (4). Further imaging, including CT angiography and arteriography, is left to the discretion of the consulting vascular surgeon.

Do patients benefit from this aggressive approach of resecting and reconstructing the carotid artery? Without carotid resection, Roh in Korea evaluated patients who received chemoradiotherapy alone or palliative treatment for stage IVB disease, and none of the patients survived longer than 15 months (5). Snyderman’s meta-analysis of 158 patients reported a 22% 2-year disease-free survival (6). Other studies have reported 1-year disease-free survival to be as high as 44% (7–9). Katsuno reported 40% to be free of disease at 2 years (10). The rate of distant metastases also decreased in the absence of recurrence in the neck (1).

Carotid resection and reconstruction can be done with an acceptable 5% stroke rate and 7% mortality rate, as reported in Katsuno’s retrospective review of 148 patients (10). Ozer reviewed 18 patients and reported a combined stroke and mortality rate of 5.5%, while Freeman reported an overall perioperative mortality rate of 3% in a review of 58 patients (11, 12). Some reports show no significant difference of stroke risk in carotid artery ligation versus reconstruction (6, 13). Others show a 30% to 50% mortality rate and stroke incidence with elective ligation (7, 14). Meleca reported neurologic sequelae in 7 of 12 patients who underwent elective ligation versus 1 of 8 patients who underwent interposition graft reconstruction (15). Brennan reported a 29% mortality and stroke rate in seven patients who underwent resection and ligation of the carotid artery (16).

Multiple methods have been used to assess who will tolerate elective ligation of the carotid artery, including intraoperative electroencephalography, stump pressures, ocular plethysmography, somatosensory-evoked potentials in conjunction with stump pressures, and temporary balloon occlusion with xenon-enhanced CT of cerebral blood flow (17–20). No method is completely reliable, as most strokes occur 1 to 5 days after ligation secondary to ascending thrombosis from the ligated artery stump. Balloon occlusion tests have an unacceptable false-negative rate. Wright reported a stroke rate of 30% after a negative balloon occlusion test and a stroke rate of 10% after a balloon occlusion test with an adjunctive test such as electroencephalogram, single-photon emission CT, or transcranial Doppler scanning (21). Some have reported a better sensitivity when combining balloon occlusion tests with controlled
hypotension (22). These stroke rates are too high for a “safe” ligation, compared to a 5% stroke rate for resection and reconstruction in unselected patients.

The goal of oncologic surgical treatment is to achieve a complete resection (R0). When faced with carotid encasement or involvement, surgical options include resection and elective ligation of the carotid artery, peeling the tumor off the carotid, or resection with reconstruction of the carotid.

Peeling the tumor from the carotid artery has several pitfalls. First and foremost, since it is not an oncologic resection, microscopic residual tumor may be left on the vessel wall of the carotid artery (23). Huvos’ examination of 64 resected carotid arteries found that 70% had involvement of the carotid wall or sheath with invasive squamous cell carcinoma (24). Peeling also compromises blood flow to the arterial wall, which weakens the wall, increasing the risk of carotid rupture (1, 25).

Reconstruction can be done using an autogenous vein, autologous artery, or prosthetic material such as PTFE graft. Jacobs argued that using the superficial femoral artery is superior to using vein because it tolerates infections well without the need for a pharyngostome or myocutaneous flap (26, 27). Sessa re-analyzed 97 carotid reconstructions, finding 70% had involvement of the carotid wall or sheath with invasive squamous cell carcinoma (28). Peeling also compromises blood flow to the arterial wall, which weakens the wall, increasing the risk of carotid rupture (1, 25).

Our vascular surgeons prefer to use a prosthetic graft like PTFE with the thought that autogenous vein may dilate and become ectatic over time. Miao in China reported 13 cases of PTFE along with myocutaneous flaps (30). One graft blowout secondary to a pharyngocutaneous fistula was treated with ligation and resulting in no neurological deficits. We believe that coverage of the reconstructed carotid artery with nonradiated fields, with only one out of 20 patients having a graft blowout, treated by ligation without stroke (21). In our series of patients, three patients had resection of the pharynx or esophagus; one was reconstructed using PTFE, and two were reconstructed using autogenous vein (cephalic vein and greater saphenous vein). There were no graft blowouts in the face of these infected and radiated fields.

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Although this is a small series of 10 patients, we have found that the collaboration of head and neck surgeons with vascular surgeons provides the patient with a complete oncologic resec-


