Endovascular Therapeutic Management of Carotid Blowout Syndrome in Head and Neck Cancer Patients

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ABSTRACT

Objectives: Discuss the endovascular treatments for carotid blowout in patients with advanced head and neck cancers and present a decision-making algorithm for management at initial presentation and for choosing the appropriate endovascular technique.

Methods: Retrospective review of three cases of acute or imminent carotid hemorrhage managed with either endovascular stents or permanent endovascular occlusion.

Results: One patient presented with acute carotid blowout, whereas two patients presented with probable sentinel bleeds. One patient was deemed appropriate for undergoing permanent balloon occlusion (PBO) after passing a balloon occlusion test when carotid angiography revealed a small hemorrhagic pseudoaneurysm. The other two patients were treated with endovascular stents as they were believed to be at significant risk for stroke if the carotid artery became occluded. All three patients achieved immediate hemostasis. The PBO patient exhibited no major complications and was without any evidence of rebleeding 6 years following occlusion. One patient suffered a stroke 2 months post-stent-placement and died 4 months later of disease progression. The other patient suffered a rebleed episode one month post stent-placement and died of disease progression a month later.

Conclusions: There are several technical limitations to either endovascular permanent occlusion or stent-graft placements, along with many confounding clinical variables that must be taken into consideration in choosing the appropriate endovascular treatment in carotid blowout syndrome. For short-term control of hemorrhage, both occlusion and stenting have been shown to be quite effective, while the literature and our own experience suggest that endovascular occlusion provides a longer period of hemostasis with less associated complications than stent placement

INTRODUCTION

In the context of surgical and nonsurgical treatments for cancers of the upper aerodigestive tract, carotid rupture is a potentially catastrophic complication. Effective and safe surgical interventions for carotid rupture have been challenged by the acuity of the clinical presentation and the underlying morbidity of its etiology. As such, endovascular management has assumed an increasing role in the treatment paradigm for such patients. Benefits of such treatment include localization of the precise site of vessel involvement via selective angiography, less surgical risk to the patient, and less trauma to the vasculature. [1]

Risk factors, which lend themselves to carotid artery exposure and further potentiate the risk of rupture include tumor recurrence, infection, flap failure, pharyngocutaneous fistula, radiotherapy, and the presence of long-term nasogastric tubes. In particular fistula formation with the associated erosive nature of saliva is a well-documented predisposing postoperative complication. Additionally, infection assumes a pervasive role among reported case series, which further complicates definitive treatment. [10]

The clinical presentation of carotid blowout syndrome is variable ranging from carotid exposure within the treatment field to acute trans-oral or trans-cervical hemorrhage. The presence of a sentinel bleed, often indicating an underlying pseudoaneurysm with imminent rupture, demands immediate intervention in an effort to capitalize on the lead-time rarely afforded to the acute rupture. Initial management is geared toward fluid resuscitation, cardiovascular stabilization, and definitive control of the site of hemorrhage. (Fig. 1)

Traditional treatment focused on operative ligation of the carotid artery with the resultant risk of acute stroke and operative mortality. However advancements in angiography techniques, first with the advent of the detachable balloon occlusions and coils and later with covered stents, has provided an alternative mode of treatment with fairly high rates of reported technical success in achieving short-term hemostasis in carotid artery ruptures using endovascular occlusion and endovascular covered stent grafts. [4,5]

The success of these endovascular techniques has strengthened the treatment options to what was once a dismal prognosis. However, the similar rates of success in obtaining hemostasis using a permanent occlusion or a covered-stent to treat carotid blowout patients presents a dilemma in choosing one modality over another. There are certain technical limitations to consider in either technique that may force the provider to choose one technique over another. Moreover, unfortunately, due to the high number of comorbities in this subset of patients, there are many clinical considerations in choosing one endovascular technique over another. Here we present our institutions experience with endovascular treatment of carotid rupture. Also we present a simplified decision-making algorithm in initial management and in choosing the appropriate endovascular treatment for carotid rupture based upon the summary of the literature.

Case Presentation

Case 1: Patient is a 55 y/o male diagnosed with stage IV(T4N2bM0) squamous cell cancer of the right oropharynx treated primarily with combined chemoradiation therapy. Twelve months from time of initial diagnosis, the patient presented to the emergency department with massive hemoptysis. Exam at that time revealed a large mass in the right oropharynx and hypopharynx with central ulceration. Computer tomographic scan revealed invasion of the skull base with a thrombosed right internal jugular vein and tumor encasement of the proximalinternal carotid artery.

Selective angiography of the common, external, and internal carotid artery was performed demonstrating erosion of the posterior wall of the distal common carotid artery and proximal aspect of the internal carotid artery, with involvement of the carotid bulb (Fig. 3) A 0.018 wire was placed in the petrous portion of the internal carotid artery followed by using an 8mm x 40 mm long polytetrafluoroethlene (PTFE) covered self expanding stent was placed to spanacross the diseased segment of common and internal carotid artery with complete resolution of bleeding. The external carotid artery origin was sacrificed by the use of the covered stent. Completion angiography revealed no evidence of persistent vasospasm, no flow into the external carotid artery and, no evidence of thrombo-embolic complication.(Fig. 4)

One month later, the patient experienced and an episode of moderate recurrent hemoptysis which led to the discontinuation of aspirin and clopidogrel (Plavix). The source of hemorrhage was thought to originate from the oropharyngeal mass itself, not from the stented vessel. The patient's bleeding resolved completely following discontinuation of anticoagulant therapy and he remained free of bleeding throughout the remainder of his clinical course. Two months post stent placement, the patient suffered a stroke which left him paretic on his left side. Six months post stent placement, the patient died from disease progression

Case 2: The patient is a 64y/o male diagnosed with stage IV squamous cell cancer carcinoma of the oroharynx which was treated primarily with combined chemoradiation. Eleven months following treatment, the patient was admitted for significant hemoptysis, dysphagia, and pulsatile tinnitus. A large clot was evacuated out from his oral cavity, revealing a large tumor extending from the left tonsil into the base of tongue and anterior tongue.

Computer tomographic scan demonstrated a questionable ulceration versus tumor invasion into the left carotid artery. In similar fashion, the patient underwent endovascular stenting of the left carotid artery with resolution of upper airway bleeding. One month later, the patient developed a limited episode of bleeding from his tracheotomy site. This resolved with the discontinuation of clopidogrel (Plavix) and the patient was transferred to hospice care. The patient remained free of further bleeding episodes until he died from his disease two months following stent placement.

Case 3: Patient is a 70y/o male diagnosed with squamous cell carcinoma(T3N0M0) of the larynx which was treated primarily with a laryngectomy and radiation adjuvant following surgery. Approximately one month following the primary surgery, the pt developed osteomyelitis of cervical spine regions 5-7 (C5-C7) and subsequently underwent a corpectomy/fusion of C5-C7. Soon afterwards the right cervical incision broke down forming a pharyngeal cutaneous fistula. Subsequently the patient underwent coverage with a right pectoralis free flap on POD#7 and soon afterwards developed several episodes of self-limited oropharyngeal bleeding suspicious of a blow-out bleed from the carotid artery.

Bilateral angiogram of the patients' carotid arteries revealed a small pseudoaneurysm arising within the proximal right common carotid artery. (Fig. 5) Due to the patient's radiation fibrosis of the neck, history of anastomotic breakdown, fistula formation, and general medical condition, the safest approach was determined to be to perform a temporary balloon occlusion and if the patient passed, a parent vessel sacrifice via occlusion. The patient showed no neurologic changes after 25 minutes of temporary occlusion of the right common carotid artery.

After passing the temporary occlusion, three detachable 1.5mL silicon balloons were introduced into the common carotid artery followed by a series of 0.038 inch fibered coils into the stump of the right common carotid artery to secure positioning of the balloons and promote thrombosis. Post-embolization angiogram following placement of balloons and coils demonstrated complete occlusion of the right common carotid artery (Fig. 6) A post-embolization angiogram of the neck was performed, demonstrating, filling from the left facial artery to the right facial artery and, in a retrograde fashion, filling the proximal right external carotid artery and the artery to the free flap. (Fig.7) The patient did well-postoperatively with no neurologic morbidity and has survived 6 years post-embolization without major complications and no episodes of rebleeding.

RESULTS

Figure 3: Angiography performed from the common carotid artery demonstrates erosion of the posterior wall of the distal common carotid artery and proximal aspect of the internal carotid artery (yellow arrow), with involvement of the carotid bulb. Diffuse narrowing of the proximal branches of the external carotid artery with distal dilatation of the maxillary artery is consistent with prior radiation therapy of the neck. Additionally, webs are present within the proximal internal carotid artery, which are also consistent with prior radiation therapy.

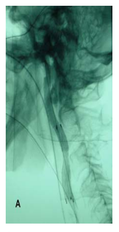


Figure 4: Unsubtracted common carotid artery angiography demonstrates placement of the polytetrafluoroethylene (PTFE) covered self expanding stent and distal uncovered self expanding stent within the distal common carotid artery and proximal extracranial internal carotid artery. External carotid arterial flow has been eliminated by the covering of its origin with PTFE .

Figure 5: Angiography performed from the common carotid artery demonstrates a small pseudoaneurysm arising within the right proximal carotid artery, pointing slightly posteriorly (arrow)

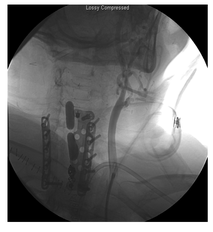
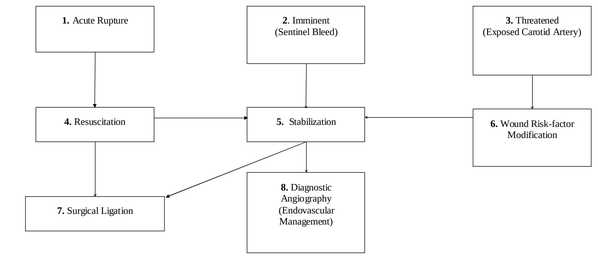


Figure 6: Oblique view of left common carotid artery. Right common carotid artery has been occluded for a pseudoaneurysm with 3 balloons followed by coil embolization. Additionally, the patient's hardware from a prior anterior cervical disc fusion and posterior fusion are appreciated

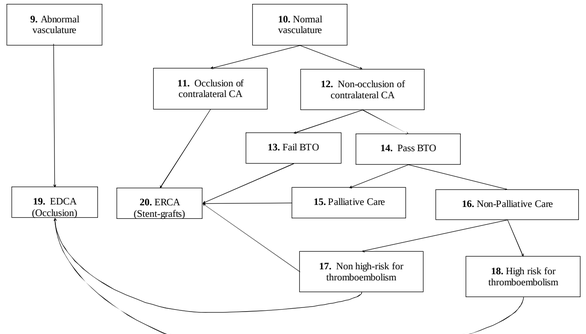
Figure 7: Left common carotid artery angiogram showing collateral flow across the facial artery to the fibular free flap

Figure 1: Initial Management of Carotid Artery Blowout in Head and Neck Cancer Patients.



Box 1: Acute rupture is defined as a patient who presents with acute profuse hemorrhage that is not self- limited or well-controlled with packing or pressure as complete rupture has occurred, immediate resuscitation is a priority.[1]
Box 2: Imminent rupture is defined as a patient who presents with an episodic profuse hemorrhage that is self-limited or controlled with pressure or pharyngeal packing, rupture can occur at anytime.[1]
Box 3: Threatened rupture is defined as an exposed carotid artery due to the patient's wounds which has broken down postoperatively; without coverage by well-vascularized tissue rupture is inevitable.
Box 4: Immediate resuscitation is necessary for acute ruptures and a possibility for imminent ruptures, resuscitation consist of: airway management (emergency cricothyroidotomy may be necessary), fluid-resuscitation with preferably four large-bore intravenous lines, readily available blood and crystalloids, hemostasis of bleeding site with nasal or pharyngeal packing, central-venous access, arterial line, pulmonary artery catheter, ICU-monitoring
Box 5: Stabilization before any further intervention;, basic guidelines by Porto et. al; Systolic blood pressure >110mm Hg, Pulse = 60-100BPM, PO2> 70mmHG, Hemoglobin > 11g/100ml
Box 6: Exposed artery is liable to rupture at anytime. Modify known risk factors such as wound infections, pharyngocutaneous fistulas, and myocutaneous flap necrosis with primary coverage with another vascularized flap, bypass salivary exposure with repair of fistula or a salivary bypass tube, good local wound-care includes debridement, appropriate cultures, and topical antibiotics, dressing changes and IV antibiotics if necessary. Boost immune system with good diabetes control and good nutritional support.
Box 7: Surgical ligation is associated with high perioperative morbidity and mortality but maybe necessary in acute rupture cases if emergent after stabilization or possibly directly after resuscitation as a life-saving measure. Procedure requires adequate vascular exposure via separate skin incisions above and below the necrotic area, involved arteries are suture-ligated, and stumps buried into available muscles. Can be done under local anesthesia if general anesthesia is prohibitive.
Box 8: Use of diagnostic angiograms allows for precise localization and cause of hemorrhage in carotid blowout and has allowed the discovery of many lesions that would have otherwise been missed. Angiograms (computer-tomography scan angiography or conventional catheter angiography) should be used for imaging of the cervical and intracranial carotid circulation bilaterally as study by Chaloupka et al. (1999) has shown that the contralateral carotid artery from initial carotid artery blowout is affected 46% of the time in rebleeding. Angiograms of the common, internal, and external carotid artery should be assessed for any potential endoluminal irregularity/disruptions, pseudoaneurysm formation, and extravasation. If no vascular abnormality is apparent in threatened carotids there may be no further intervention than risk modification.

Figure 2 Endovascular Therapeutic Management to Carotid Artery Blowout in Head and Neck Cancer Patients



Box 9/10: For the use of ERCA, patient needs to have certain favorable anatomic and pathophysiologic factors, which includes a relative lack of any stenoses secondary to post-radiation or atherosclerotic changes. Relatively straight carotid and brachiocephalic arteries and a common femoral and iliac artery that allows for placement of a large caliber vascular sheath. If the patient has any of these abnormalities, the patient would be considered for an EDCA instead.
Box 11/12: If there is occlusion of the contralateral common or internal carotid artery secondary to prior therapy or from disease progression, then the patient is excluded from use of EDCA because of the certainty of cerebral ischemia from bilateral carotid occlusion and would be considered for an ERCA as an alternative option.
Box 13/14: If patient fails a balloon test occlusion (BTO), patient is excluded from consideration from use of EDCA because of the likely risk of cerebral ischemia and would be considered for an ERCA as an alternative option.
Box 15/16: ERCA has been shown to be an effective modality for short-term hemostasis and is a preferable option for palliative care over EDCA because of less-risk for cerebral ischemia for the patient allowing the patient to enjoy a better quality of life without having neurologic deficiencies from a possible stroke. Even if the patient has passed a balloon occlusion test, 15-20% of patients who undergo EDCA can develop immediate or delayed cerebral ischemia.
Box 17/18: ERCA has been reported to have a higher risk of thromboembolism especially without judicious or inexperienced use of antiplatelet and antithrombotic therapy. If patient already has pre-disposed risk-factors for thromboembolism or if the patient's is at substantial risk for further bleeding in which antithrombotic therapy must be stopped, EDCA maybe a better alternative. If there is no higher risk of thromboembolism, an EDCA or ERCA may be options. Minimal complications of thromboembolism achieved by W. Lesley et al. with following regimen: Clopidogrel 75mg PO daily and aspirin 325 mg PO daily began immediately after stent-graft placement.
Box 19/20: EDCA: Use of balloons, coils, embolizing agents such as acrylic adhesives to occlude the diseased carotid artery and stop the hemorrhage. ERCA: Use of covered self-expendable or balloon-mounted stents to preserve the diseased carotid artery and stop the hemorrhage.

Discussion

With a reported 4.3% incidence, carotid blowout syndrome (CBS) is a rare yet dreaded complication of radical neck dissections in head and neck cancer patients. For patients with irradiation therapy the outlook is even worse with a a 7.6 fold increase in risk. A surgical approach in management of CBS has been grim with a cumulative 60% neurological morbidity and cumulative 40% mortality rate.[11]

Fortunately advancements in imaging and interventional radiology have led to a less-invasive and more effective endovascular treatment of CBS. The two types of endovascular approaches can either be classified as deconstructive management with balloons, coils, or acrylic adhesives to occlude the diseased carotid artery or reconstructive management with stent-grafts to preserve the diseased artery.

Technical success rates up to 89% for endovascular deconstructive carotid artery repair (EDCA) and 96% in endovascular reconstructive carotid artery (ERCA) have been reported for CBS patients.[4,5] These results imply that for short-term hemorrhage , both modalities of treatment are fairly successful. In regards to the long-term prognoses of these patients, especially regarding a recurrent bleed in CBS, the results have been less promising with a reported 25% - 26% rate of hemorrhage in patients with either an EDCA or ERCA.[8]

In addition, although there has been no conclusive evidence to suggest that the use of EDCA provides a better long-term hemostasis and less-complications than the use of ERCA, the literature does suggest a longer period of hemostasis.[8] Our experience has been similar to that in the literature in that both our patients with ERCA had rebleed episodes and relatively shorter survival rates but our EDCA patient has survived for 6 years without any rebleed episodes. These findings are complicated by the fact that often times these subset of patients are afflicted with multiple comorbities and succumb to complications of their comorbidities.

In certain situations such failure to tolerate a balloon test occlusion (BTO) or an occlusion in the contralateral carotid artery secondary to prior therapy or a concurrent occlusive arteriopathy, the certainty of cerebral ischemia would leave ERCA as the only other viable therapeutic option. Our institutions experience with the use of ERCA has been similar to the experience of other institutions in that both of our patients that underwent ERCA had initial successful hemostasis and a rebleed event in 1 and 2 months.

Furthermore there are reported complications of graft infections, endoleaks, stent extrusions, and especially the risk of thromboembolism associated with the use of ERCA. [9] Although it has been shown that the judicious use of antiplatelet agents can help decrease the risk of thromboembolism, this in itself can be a major challenge. As with our patients in case 1 and 2, the use of antiplatelet agents had to be withheld in order to gain hemostasis from rebleeding. As a consequence, our patient in case 1 eventually suffered a thromboembolic event which left him with a permanent neurologic morbidity.

Here we present our institutional experience with imminent and acute carotid rupture, which were effectively treated in the acute setting with endovascular surgical management. The treatments were successful in halting the short-term bleeding and provided a palliative benefit to two of our patients in the months that followed and a long-term benefit for 6 years in our third patient. Our experience highlights the application of endovascular techniques in a specific population of post-irradiated patients, serving as an effective alternative to more traditional approaches to include surgical ligation. Although there are still many improvements to be made in the use of endovascular treatment for carotid blowout patients the challenge now is in deciding the right modality of endovascular treatment in these patients as summarized in Figure 2.

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