Carotid blowout syndrome: efficacy of endovascular treatment methods

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Purpose: To establish the hemostatic efficacy, complications, and outcomes of endovascular treatment for carotid blowout syndrome (CBS). Due to the rarity of this condition, the experience in endovascular treatment of CBS is not well defined. Materials and Methods: A retrospective analysis was conducted on 11 patients with head and neck cancer who underwent endovascular treatment for CBS over a 10-year period from 2004-2014 at a tertiary care center. Relevant demographic and pre-procedural clinical and laboratory data were collected. Rate of technical success of stent graft placement versus carotid occlusion via embolization was assessed with a primary endpoint of hemorrhage cessation and secondary endpoints of immediate complications and maintenance of hemostasis. Results: All patients received chemo- and radiation therapies prior to endovascular treatment for CBS and neck dissections occurred in 7 of 11 (64%) patients. Within the occlusion group (n=5), 3 patients had squamous cell carcinoma (SCC), 1 patient had adenoid cystic carcinoma, and 1 patient had chondrosarcoma. All patients within the stent group (n=6) had SCC. Active hemorrhage was present in 3 of 5 (60%) occlusion and 2 of 6 (33%) stent patients at intervention. Immediate hemostasis was achieved in all patients. One stent patient required multiple reinterventions for delayed hemorrhage. The most common complication was stroke, occurring in 2 of 5 (40%) occlusion and 1 of 6 (16%) stenting procedures. Three patients died prior to discharge (2 occlusion, 1 stent), with 6 of 8 remaining patients discharged to hospice with mean time-to-death of 8 and 39 days for occlusion and stent patients, respectively. Conclusion: Although carotid occlusion has been hypothesized as more effective in achieving immediate hemostasis for patients with CBS, it is likely to be associated with a higher rate of acute stroke due to complete cessation of blood flow through the internal carotid artery. Our findings suggest that occlusion is likely more efficacious in achieving both immediate and sustained hemostasis. However, immediate complications, such as acute stroke, appear to be less common in patients with stent placement.

Keywords: Carotid Blowout Syndrome; CBS; head and neck cancer


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Introduction

Rupture of the carotid artery or its branches, known as carotid blowout syndrome (CBS), is a potential life-threatening delayed complication of head and neck cancer treatment, with a reported incidence of 4.3% after radical neck dissection [1,2]. Clinical severity can range from acute rupture with hemorrhage to threatened hemorrhage due
to an externally-exposed carotid artery [3-5]. CBS is more common in head and neck cancer patients with radiation-induced necrosis, recurrent tumors, and local wound complications including infection and pharyngocutaneous fistulae [1-3]. Although relatively rare, CBS has neurologic morbidity and mortality rates of 60% and 40%, respectively, and is difficult to manage with both surgical and endovascular interventions [2, 6].

The majority of patients treated for CBS undergo some form of endovascular therapy. Often, emergency surgical ligation is not preferred due to the difficulty of surgical dissection in the setting of prior surgery and/or irradiation [2, 7]. Conversely, real-time angiographic assessment of anatomy and pathology during endovascular procedures enables targeted therapy in the context of a specific clinical scenario.

Endovascular treatment of CBS can be performed with either deconstructive or reconstructive methods, each of which possesses unique advantages and disadvantages. The deconstructive method sacrifices the carotid artery with the goal of permanently occluding it using an endovascular occlusion device, such as coils or detachable balloons [7]. However, a major limitation of this technique is a 15-20% risk of immediate or delayed cerebral ischemia with complete occlusion of the internal carotid artery [2]. This risk is mitigated by performing a preliminary balloon occlusion test to assess for collateral blood flow through a patent circle of Willis, although the risk of stroke is not entirely eliminated [2, 3, 6, 8]. Additionally, a balloon occlusion test may not be practical in a hemodynamically unstable or profusely bleed patient [7]. The reconstructive method of carotid artery endovascular repair utilizes expandable endovascular stent grafts to establish hemostasis [7]. There are several theoretical advantages of the reconstructive approach, including a decreased risk of a neurologic insult. However, some small retrospective studies have demonstrated less than favorable outcomes after carotid artery stent graft placement in the setting of CBS [2, 4, 7, 9].

The clinical utility and appropriateness of endovascular intervention among patients with CBS depends on several poorly defined factors, including the rate of technical success, as well as initial and delayed complications, duration of hemostasis, and stent graft patency [9]. Overall, there is a paucity of scientific literature evaluating endovascular treatment of CBS and the majority of individual institutions have little experience treating this relatively rare, but devastating, condition. Therefore, the purpose of this study was to improve understanding of clinical outcomes of patients with CBS undergoing stent graft placement compared to carotid artery occlusion in order to more effectively triage patients to the most appropriate therapy. The primary objective was to assess differences in initial achievement of hemostasis between treatment methods. Secondary objectives include hemostatic efficacy, complications, and outcomes of endovascular treatment for CBS.

Materials and methods

A retrospective analysis was conducted on eleven patients with head and neck cancer who underwent endovascular treatment for CBS over a ten-year period from 2004-2014 at a tertiary care academic institution. This time frame was selected to provide the largest possible sample size given the relatively rare occurrence of CBS, as well as the more recent application of endovascular stents to this condition.

All patients with head and neck cancer presenting with CBS who were treated with an endovascular intervention at our institution by one of three board certified neurointerventional radiologists during the past ten years were eligible for inclusion. Patients meeting any of the following criteria were excluded from this study: no pathologic confirmation of head and neck cancer, prior episodes of CBS managed by another institution, or involvement of the external carotid or smaller branch arteries not amenable to stent graft placement. Patients meeting inclusion criteria were identified through our institutional electronic medical record, utilizing CPT codes to select desired exams within the specified dates. Institutional review board (IRB) approval was obtained to review patient records.

Patients were classified into one of three types of CBS to determine case urgency: threatened, impending, and acute [2, 6, 7]. For this study, threatened CBS was defined as an externally exposed carotid artery with a high risk for future hemorrhage. Impending CBS was defined as one or more sentinel bleeding episodes in the absence of ongoing hemorrhage, while acute CBS was defined as the presence of ongoing active hemorrhage.

Demographic and pre-procedural clinical and laboratory data were collected, such as comorbid conditions, medications, coagulation parameters, primary tumor types, prior oncologic therapies, status of malignancy, and other loco-regional factors. A board certified radiologist with over ten years of subspecialty certification in neuroradiology and interventional radiology and a radiology resident reviewed procedural fluoroscopic images, as well as computed tomography (CT) and/or magnetic resonance (MR) angiography of the neck, if available. After carotid occlusion or stent graft placement, the angiographic images and medical record were reviewed for persistent bleeding, neurologic deficits, and other complications. Rate of
technical success of stent graft placement versus carotid artery embolization was assessed with a primary endpoint of immediate hemorrhage cessation and secondary endpoints of procedural complications, maintenance of hemostasis, and need for re-intervention during the initial 30-day follow-up period, as well as length of hospitalization, discharge status, and time-to-death.

Patient and procedural characteristics were summarized using descriptive statistics (mean and standard deviation for continuous variables and count and percentage for categorical variables). Procedural outcomes of stent placement or carotid occlusion were also compared. Statistical analyses were performed using SPSS Version 22.0 software (IBM Corp, Armonk, NY) and statistical significance was determined using p-values <0.05.

Results

All eleven patients received chemo and radiation therapies prior to endovascular treatment for CBS. Five patients (45%) underwent occlusion procedures with coil embolization (Figure 1), while six patients (55%) received stent grafts (Figure 2). All patients were male, except for a single female in the occlusion group. Mean age was 51.2 (SD=10.8) in the occlusion group and 58.5 (SD=21.2) in the stent group. As shown in Table 1, comorbidities such as tobacco use, hypertension, and heart disease were common in both groups, as were predisposing conditions such as concurrent infection, superficial ulceration, active malignancy, and presence of a surgical airway (e.g., tracheostomy).

Neck dissections occurred in 64% (n=7) of all patients. Within the occlusion group (n=5), three patients had squamous cell carcinoma (SCC), one patient had adenoid cystic carcinoma, and one patient had chondrosarcoma. All patients within the stent group (n=6) had SCC. Acute CBS was present in 60% (n=3) of occlusion and 33% (n=2) stent patients at intervention. Impending CBS was present in 40%
Table 2. Patient Outcomes

<table>
<thead>
<tr>
<th>Variable</th>
<th>Stent Placement (n=6)</th>
<th>Embolization (n=5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Immediate Hemostasis, n (%)</td>
<td>6 (100)</td>
<td>5 (100)</td>
</tr>
<tr>
<td>Stroke, n (%)</td>
<td>1 (16.7)</td>
<td>2 (40.0)</td>
</tr>
<tr>
<td>Reintervention for Delayed Hemorrhage, n (%)</td>
<td>1 (16.7)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>Length of Hospitalization (days), mean (SD)</td>
<td>15.2 +/- 12.6 (3-37)</td>
<td>4.0 +/- 2.6 (1-7)</td>
</tr>
<tr>
<td>Mortality</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prior to Discharge, n (%)</td>
<td>1 (16.7)</td>
<td>2 (40)</td>
</tr>
<tr>
<td>90-day, n (%) (mean time to death) days</td>
<td>3 (39.3)</td>
<td>3 (8.2)</td>
</tr>
<tr>
<td>Goals of Care</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Palliative Care/Hospice</td>
<td>3 (50.0)</td>
<td>4 (80.0)</td>
</tr>
<tr>
<td>Aggressive/Life Prolonging</td>
<td>3 (50.0)</td>
<td>1 (20.0)</td>
</tr>
</tbody>
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Figure 2. Anteroposterior and oblique DSA images demonstrating a pseudoaneurysm arising from the common carotid artery (left) with subsequent stent placement (right) and resultant exclusion of the pseudoaneurysm.

(n=2) of occlusion and 50% (n=3) of stent patients at intervention. A single patient with threatened CBS was in the stent group. In occlusion patients, CBS involved both right common and internal carotid arteries in 60% (n=3) and the left internal carotid artery in 40% (n=2). In stent graft patients, CBS involved the right common carotid artery in 50% (n=3), the left common carotid artery in 33% (n=2), and the right internal carotid artery in 17% (n=1).

Immediate hemostasis was achieved in all patients. As shown in Table 2, the only procedural complication was clinically significant stroke, occurring in 40% (n=2) of occlusion procedures and 17% (n=1) of stenting procedures. A single patient within the stent group required multiple angiographic evaluations due to delayed hemorrhage presenting at day 19 post-intervention, which was subsequently attributed to a branch of the external carotid artery. Post-intervention transfusion requirements were low with three patients receiving a total of five units of packed red blood cells. Three patients died prior to discharge (2 occlusion, 1 stent), with six of the eight remaining patients discharged to hospice with a mean time-to-death of 8 and 39 days for occlusion and stent patients, respectively.

Discussion

Endovascular intervention is the preferred treatment for CBS given its high morbidity and mortality, as well as technical difficulty of surgical ligation in the setting of prior head and neck cancer therapy [2, 7, 10]. Appropriate patient selection and triage to coil embolization or stent graft placement is guided by multiple case-specific variables. For example, stent graft placement may be preferred for acute CBS due to practical limitations in performing a balloon occlusion test in an unstable patient, while embolization should be considered for threatened CBS because a long...
segment of the carotid artery is frequently at risk for hemorrhage [7].

The largest limitation of our study is the small sample size, which limits our ability to determine clinically significant differences between occlusion and stent graft placement outcomes with certainty. Although no deaths were attributable to treatment failure or procedure-related complications, patients with CBS experience a high mortality, limiting follow-up to a relatively short duration.

Our findings suggest carotid occlusion and stent graft placement are equally efficacious in achieving immediate and sustained hemostasis for patients with CBS. Delayed recurrent hemorrhage occurring in one stent group patient was attributed to an ipsilateral external carotid branch and was not considered a treatment failure. Furthermore, our study suggests that the risk of neurologic insult is higher with carotid occlusion than stent placement. Clinically significant strokes occurred despite the reassuring preliminary findings of a balloon occlusion test, possibly due to procedure-related thromboembolism. Additionally, increased risk of infection and stent thrombosis is a theoretical disadvantage of stent graft placement that was not encountered throughout the duration of patient follow-up [7]. The increased relative mortality of patients within the occlusion group most likely reflected patients’ underlying disease process and functional status, rather than procedure outcome.

Due to the rarity of CBS, there is a paucity of scientific literature evaluating the utility of endovascular treatment. A systematic review of the existing literature may be useful to further elucidate clinically significant differences between stent placement and carotid occlusion for CBS. Additional future research should focus on evaluating the utility of endovascular treatment of external carotid hemorrhage and recurrent hemorrhage in the setting head and neck cancer.

**Conflicting interests**

The authors have declared that no conflict of interests exist.

**References**