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HEAD AND NECK

Endovascular management of the carotid blowout syndrome: a single-center experience

Hasanali Durmaz[1] · Onur Ergun[1] · Erdem Birgi[1] · Ömer Bayir[2] · Güleser Saylam[2]

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Abstract

Purpose It is aimed to present endovascular treatment of carotid blowout syndrome (CBS) in patients with head and neck cancer.

Methods A retrospective review was performed on patients with carotid blowout syndrome between 2012 and 2018 in our hospital. A total of ten patients with prior history of head and neck cancer surgery and radiation therapy were investigated with clinical, postoperative and follow-up findings as well as technical outcome. Digital subtraction angiography of the carotid arteries was performed in all the cases for the diagnosis of the source of bleeding. Detachable coils and covered stents were used in endovascular treatment of carotid blowout syndrome. After the procedures, all patients were admitted to the intensive care unit for the follow-up of both hemodynamic and neurologic conditions.

Results Thirteen diagnostic and endovascular treatment sessions were performed in 10 patients. Seven patients had major surgery for head and neck cancer and all patients were treated with chemoradiotherapy. Head and neck cancers in seven of the ten patients were persistent and pharyngocutaneous fistula developed in five patients. Two patients had impending CBS and eight patients had acute CBS. A total number of 19 vascular lesions in 10 patients were detected and 4 patients had multiple lesions. In three patients, additional endovascular treatment of stent-graft deployment had required due to recurrent hemorrhage after a mean time of 5.33 days (range 1–11 days).

Conclusions As a conclusion, covered stent application with or without coil embolization is a safe and efficient technique in treatment of CBS secondary to head and neck cancers.

Keywords Carotid arteries · Endovascular procedures · Embolization · Stents

Introduction

Carotid blowout syndrome (CBS) is a life-threatening complication in patients with head and neck tumors, defined as the rupture of common carotid arteries and its branches. The incidence of CBS in patients who underwent surgery and received re-irradiation for head and neck tumors varies between 2.9–4.3 and 2.6–10%, respectively [1]. Due to acute hemorrhage, morbidity and mortality rates are high even when treated surgically or with endovascular methods [2].

Surgical revision or ligation has been used as the traditional treatment method in past [1]. However, surgical exploration or repair of the necrotic and infected tissues in CBS is technically difficult, particularly in patients with a history of irradiation, residual tumor and neck dissection [3, 4]. The promising results of the endovascular techniques developed in recent years changed the tendencies in management of CBS, includes coil embolization, covered

✉ Hasanali Durmaz
dr.hasan.ali.durmaz@hotmail.com

Onur Ergun
onurergun@yahoo.com

Erdem Birgi
ebirgi@gmail.com

Ömer Bayir
bayiromer@hotmail.com

[1] Department of Radiology, University of Health Sciences, Diskapi Yildirim Beyazit Training and Research Hospital, Ankara, Turkey

[2] Department of Otolaryngology, University of Health Sciences, Diskapi Yildirim Beyazit Training and Research Hospital, Ankara, Turkey

stent-graft placement, balloon occlusion, *n*-butyl cyanoacrylate (NBCA) (*glue*) and Pipeline embolization [1, 2].

In this study, it is aimed to describe the endovascular treatment technique, with attention to the technical success, perioperative complications, and efficacy.

Materials and methods

Patients

A total of ten patients presented with CBS between 2012 and 2018, treated by endovascular covered stenting and embolization in our interventional radiology unit were included in the study. All patients had prior history of head and neck cancers (larynx, $n=3$; oral cavity, $n=2$; hypopharynx, $n=2$, nasopharynx, $n=2$; salivary gland, $n=1$). All of the patients referred from *Head and Neck Surgery Clinic with the evidence of hemorrhage due to CBS* for emergency diagnostic angiography and endovascular treatment. *We have used the classification of Chaloupka* et al. *(threatened, impending or acute) according to the patients' clinical presentation and angiographic findings; 8 patients were acute and 2 patients were impending CBS. Most of the patients had required intubation during the intervention or already had tracheostomy.* All data including demographic information and clinical findings were obtained from the patients' medical records, our procedure form and digital subtraction angiography (DSA) images were retrospectively evaluated.

The ethics committee approved our study design and written informed consents were obtained from all patients.

Diagnosis and treatment

DSA of the carotid arteries, especially focused on distal common carotid artery (CCA), proximal external carotid artery (ECA), proximal cervical internal carotid artery (ICA), were performed in all cases for the diagnosis of the source of bleeding. We used transfemoral arterial approach in all patients to obtain angiograms by selective catheterization of the common carotid arteries using standard techniques. The angiographic findings such as focal endoluminal irregularity, disruption, formation of pseudoaneurysm and active extravasation from the ruptured artery were investigated (Figs. 1, 2). Endovascular treatments were performed under local anesthesia, moderate sedation or general anesthesia depending on the patients' need of airway protection, stability and cardiopulmonary support.

According to the angiographic findings, two essential techniques were used in treatment of CBS. Vessel occlusion was performed in lesions that involve proximal segment of ECA or its branches and CCA or ICA. CCA or ICA occlusion requires balloon occlusion test (BOT) to demonstrate the risk of brain ischemia especially in palliative patients (*threatened CBS*). BOT was not performed in patients included in the study because the majority of patients were

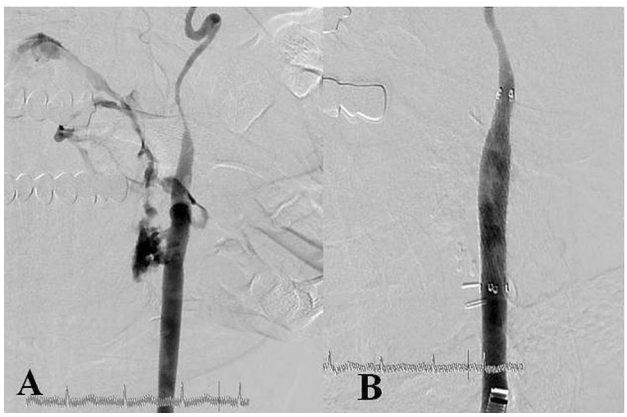

Fig. 2 Acute carotid blowout syndrome with the finding of active extravasation in common carotid artery bulbus (**a**) was treated with endovascular covered stent placement (**b**)

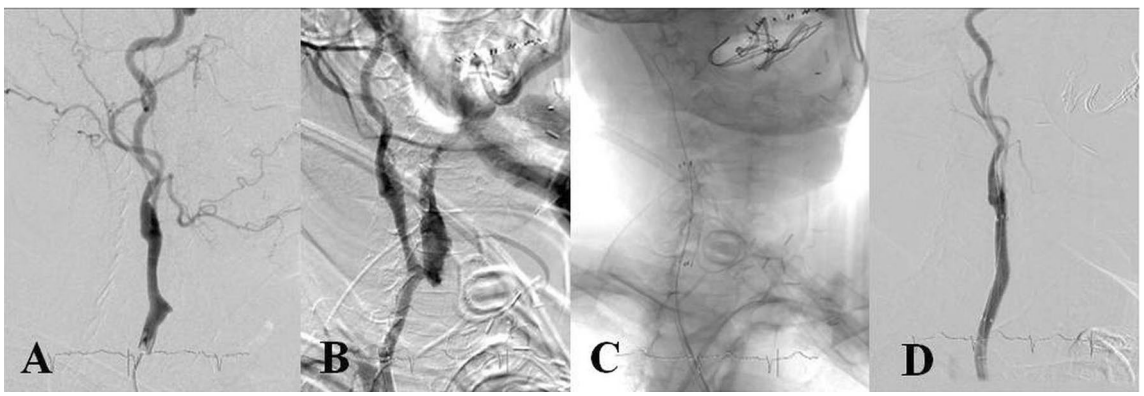

Fig. 1 Digital subtraction angiogram revealed an aneurysm (**a**) and active extravasation (**b**) in the right common carotid artery in patient with hypopharynx cancer and covered stent graft was placed immediately (**c**, **d**)

treated under emergency indications (*acute CBS*) and it was not necessary to occlude ICA or CCA in patients of impending CBS. We used detachable coils (Barricade SR Coil, Taewoong Medical, South Korea) for the occlusion of the branches of ECA in three patients and vascular plug (Amplatzer vascular plug; AGA Medical Corporation, Plymouth, MN, USA) in one patient for the occlusion of the ECA trunk by virtue of residual extravasation after coiling. Coil embolization was performed under the guidance of a guiding catheter placed in the proximal segment of the ruptured vessel and coils were placed via microcatheter that advanced coaxially. Besides the coil embolization performed in three patients, covered stents (stent grafts) (Fluency stent graft, Bard/Angiomed GmbH & Co, Karlsruhe, Germany) were used for the exclusion of a pseudoaneurysm or active extravasation in all ten patients. Depending on the location of the lesion, 4–8 mm sized stent grafts were advanced under the guidance of fluoroscopy into the CCA, ICA or carotid bulbus (Fig. 3). Before the placement of the covered stent, extravasation from the ECA branches were embolized with coils to prevent rebleeding (Fig. 4). After embolization with coils or implantation of the covered stents, verification of the flow, cessation of extravasation or exclusion of pseudoaneurysm were evaluated by angiograms. During each procedure, 70 IU/kg of intravenous heparin was administered to achieve the optimal activated clotting time and patients were anticoagulated with heparin for 24 h after the procedure.

Follow-up

After the procedures, all patients were admitted to the intensive care unit for the follow-up of both hemodynamic and neurologic conditions. The patients were prescribed daily 75 mg clopidogrel for at least 6 months and daily 100 mg acetylsalicylic acid lifelong to prevent stent thrombosis and cerebral thromboembolism. In case of the recurrent CBS, follow-up angiograms and additional endovascular treatments were performed. Technical success was defined as the immediate control of the bleeding. All patients were followed up until discharge from the hospital or death.

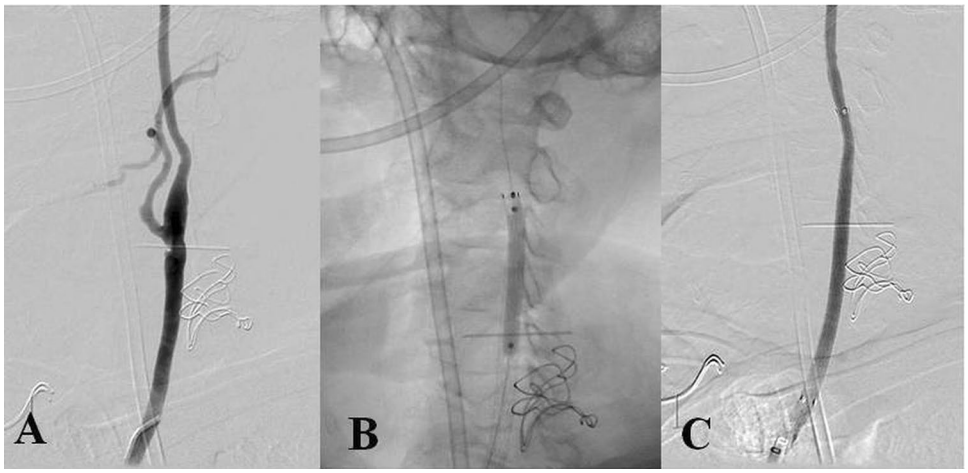

Fig. 3 Selective left carotid arteriogram revealed the filling defect and wall irregularity in distal carotid artery due to injury of head and neck cancer (**a**) and stenting with a graft-stent was performed (**b**, **c**)

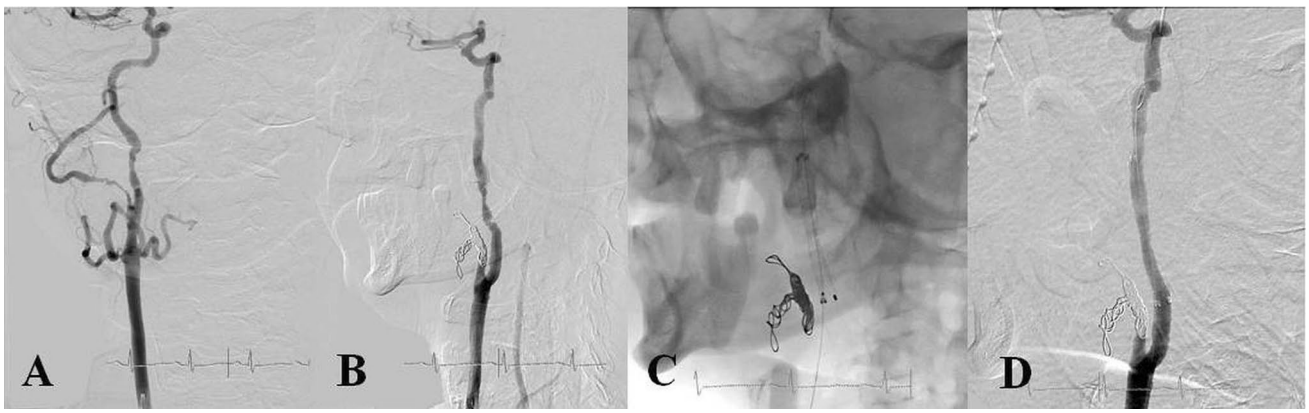

Fig. 4 Wall irregularity in the external and internal carotid artery due to tumoral invasion was seen (**a**) and covered stent-graft placement in internal carotid artery with coil embolization in external carotid artery were performed (**b**–**d**)

Statistical analysis

Mean, median, standard deviation, minimum and maximum values were used as descriptive statistics for numerical data whereas number and percentages were used for categorical data. Statistical data editing and analysis were performed using SPSS 25.0 software (IBM Corp.).

Results

The study consisted of ten patients with CBS (eight men and two women; mean age 53.2 years, range 32–71 years, SD 13.4 years). Thirteen diagnostic and endovascular treatment sessions were performed in 10 patients who were referred to our interventional radiology unit for the evaluation and treatment of CBS. In their medical history, seven patients had major surgery for head and neck cancer and all patients were treated with chemoradiotherapy. Head and neck cancers in seven of the ten patients were persistent and pharyngocutaneous fistula developed in five patients. Two patients had impending CBS and eight patients had acute CBS. A total number of 19 lesions in 10 patients were detected and 4 patients had multiple lesions. The most common lesions in patients were active extravasation ($n=8$), pseudoaneurysm with wall irregularity ($n=1$) and pseudoaneurysm with extravasation ($n=1$) involving the CCA bulbus ($n=4$), mid-distal CCA ($n=3$), ECA trunk and/or branches with proximal cervical ICA ($n=2$) and ECA trunk and/or branches with distal CCA ($n=1$). 50% of the lesions were in the right carotid artery system, 40% were in left and 10% were settled bilaterally. Covered stents were used in seven patients in management of CBS. In three patients, covered stents were used with an additional coil embolization of the ECA trunk and/or branches. In one patient, embolization with vascular plug was required because of residual extravasation after coiling. Technical success and immediate hemostasis were achieved in all patients. In three patients, additional endovascular treatment (stent-graft deployment) had required due to recurrent hemorrhage after a mean time of 5.33 days (range 1–11 days). Two patients developed hemiparesis in the periprocedural period and one patient had ischemia 3 years after the procedure. The follow-up period ranged from 14 days to 104 months (mean 13.5 months). Eight of ten patients died due to hemodynamic instability, progression of the cancer and infection. Patients' demographic data, type of CBS, DSA findings, involved arteries and endovascular treatment method are shown in Table 1.

Table 1 Patients' demographic data, type of CBS, DSA findings, involved arteries and endovascular treatment method

	Number
Gender	
Female	2
Male	8
Age (range)	53.2 years (32–71)
Head and neck cancer	
Larynx	3
Oral cavity	2
Hypopharynx	2
Nasopharynx	2
Salivary gland	1
CBS type	
Threatened	–
Impending	2
Acute	8
DSA findings	
Extravasation	8
Pseudoaneurysm with wall irregularity	1
Pseudoaneurysm with extravasation	1
Carotid arteries	
CCA bulbus	4
Mid-distal CCA	3
ECA trunk and/or branches + ICA	2
ECA trunk and/or branches + CCA	1
Treatment	
Embolization	3
Covered stent	10
Follow-up period (mean) 14 days–104 months (13.5 months)	

Discussion

CBS is the most important complication in patients with a prior aggressive surgical management or radiotherapy of head and neck cancer and requires acute intervention owing to high mortality and morbidity rates. As a life-threatening complication, rupture of the carotid arteries arises due to weakening of the arterial wall after major surgeries and radiation therapy. In the literature, there is a heterogeneous group of angiographic pathologies in patients with CBS. The most common finding in our study was extravasation at the CCA bulbus with a rate of 40% which is concordant with the literature [5].

Chaloupka et al. classified CBS in three types as *threatened*, *impending* and *acute*. Threatened CBS indicates no evidence of acute hemorrhage in patients with radical neck dissection or flap mobilization that give rise to exposed carotid arteries. Impending CBS is characterized with short and episodic hemorrhages through a surgical wound or fistula that can be demonstrated with pseudoaneurysm that bleeds intermittently. Acute CBS is the complete rupture of the carotid arteries and results with a not self-limiting hemorrhage [5]. In our study with reference to these subgroups, two of the patients were impending and eight of the patients were acute CBS.

Endovascular occlusion and endovascular repair with covered stents are the two essential treatment methods in CBS. Endovascular occlusion can be performed in the trunk of ECA. CCA and ICA can also be occluded in patients in whom BOT indicates no risk of ischemia [6]. However, 20% of the patients were reported with an incidence of delayed ischemia in patients who passed BOT [7]. In our study, coil embolization of the ECA trunk and/or branches was performed in three patients. We did not perform endovascular occlusion of CCA or ICA. We used reconstructive treatment technique with covered stents to preserve the blood flow and lower the risk for ischemic complications.

After the placement of self-expandable stent grafts, the most important complication is acute thromboembolism resulting in stroke. Delayed complications include stent stenosis, thrombosis and infection. Chang et al. reported acute stroke in three patients, carotid thrombosis in three patients and brain abscess secondary to stent infection in one patient in their series including eight patients [8]. In our study, two patients had hemiparesis in the periprocedural period and one patient had stroke 3 years after the procedure.

In the literature, it is reported that the patients treated with coil embolization survive longer than the patients treated with stent grafts. This fact is believed to be due to the less importance of the hemorrhages of the external carotid arteries compared with common or internal carotid arteries [2]. In our study, our patients were mostly suffering from the acute CBS of the common or internal carotid arteries and treated with covered stents.

Even the successful endovascular treatment of CBS, the prognosis is usually depends on the course of head and neck cancer. The mean time from CBS to death varies 4–12 months in the literature [9–11].

In patients with advanced head and neck cancer, major surgery, chemoradiotherapy history, flap necrosis, wound infections, pharyngocutaneous fistulas and persistent masses are the risk factors for CBS [12]. It should be kept in mind that CBS may develop in patients with these conditions, and if possible, endovascular interventions should be performed rapidly for palliative treatment. Since surgical treatment is technically difficult, endovascular method should be considered as a first-line treatment.

In our center, we evaluate the patients with CBS risk together as interventional radiology and otolaryngology, in terms of embolization and reconstructive treatment technique with covered stents. Thus, avoid acute CBS and reduce morbidity and mortality rates.

The major limitations of our study are its retrospective nature and the limited patient number.

In conclusion, covered stent application with or without coil embolization is a safe and efficient technique in treatment of CBS secondary to head and neck cancers. Covered stents preserve parent artery flow whilst repairing the wall defect and excluding the lesion from circulation. Endovascular treatment should be used consciously with possible early and late complications, especially in patients with acute CBS.

Author contributions All the authors were involved in the study design, had full access to the survey data and analyses, and interpreted the data, critically reviewed the manuscript and had full control, including final responsibility for the decision to submit the paper for publication.

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Compliance with ethical standards

Conflict of interest The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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