Endovascular Treatment of Penetrating Traumatic Injuries of the Extracranial Carotid Artery

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ABSTRACT

Purpose: To describe the clinical and angiographic results of endovascular therapy for traumatic injuries of the extracranial carotid artery.

Materials and Methods: The clinical and angiographic features of 36 traumatic injuries of the carotid artery during a 12-year period were reviewed. There were 35 male patients (97.2%) and 1 female patient (2.8%) with an average age of 28.8 years (range 13–60 years). Of the 36 lesions of the carotid artery, 29 (80.6%) were the result of gunshot injury, and 7 (19.4%) were secondary to stab wounds. In 24 (66.7%) instances, the injury resulted in a pseudoaneurysm; in 7 (19.4%), in an arteriovenous fistula (AVF); in 4 (11.1%), in a dissection; and in 1 (2.8%), in inactive bleeding. All patients were treated with an endovascular approach using different techniques (balloon occlusion, embolization, or stent deployment).

Results: Endovascular therapy resulted in documented lesion occlusion in 34 (94.4%) patients. Two patients declined any follow-up postprocedural imaging; however, they have remained asymptomatic. Clinical improvement was documented in 35 (97.2%) patients, and there was one procedure-related complication with fatal consequences.

Conclusions: In this series, endovascular techniques were an effective method of treatment. It was possible to use different endovascular reconstructive techniques or parent artery occlusion depending on the degree of vessel damage, with resolution of clinical symptoms and avoidance of surgery in most cases.

ABBREVIATIONS

AVF = arteriovenous fistula, CCA = common carotid artery, ECA = external carotid artery, ICA = internal carotid artery, IMA = internal maxillary artery, MCA = middle cerebral artery

The literature suggests that about 25% of cases of penetrating neck trauma are accompanied by vascular injury, with the carotid the most frequently affected artery (1,2). Traumatic lesions of the carotid artery can be classified depending on the degree of vessel wall injury as dissecting, thrombotic, pseudoaneurysm, arteriovenous fistula (AVF), or transection (3). All of these lesions have a high risk of progressing to stroke or death.

The clinical manifestations are variable, including craniocervical or thoracic pain, bleeding, dysphagia, hoarseness, hypotension, expanding or pulsatile hematoma, and neurologic deficit (4,5). The diagnostic work-up of stable patients usually includes computed tomography (CT) angiography; however, shotgun pellets can produce considerable image degradation, often requiring catheter angiography (6). Immediate surgical exploration is indicated for patients who present with signs and symptoms of shock and continuous hemorrhage from the neck wound (7,8).

Different endovascular techniques have been previously described for the treatment of neck vessel injuries. Closure of the pseudoaneurysm, AVF closure, or healing of the dissection with preservation of the parent artery is the main goal of treatment. Vessel sacrifice is sometimes indicated, however, as a last resort. The purpose of this article is to review our experience in the management of penetrating traumatic injuries of the extracranial carotid artery to determine the benefits of endovascular treatment on the basis of clinical and angiographic results.

MATERIALS AND METHODS

The clinical records and imaging studies of patients treated for traumatic extracranial carotid artery injuries during the years 1996–2008 were retrospectively analyzed, and endo-

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vascular treatment was performed in 36 patients. Institutional review board approval was obtained for this retrospective review. Surgically treated patients and patients with blunt nonpenetrating injuries were excluded from the study. There were 35 male patients (97.2%) and 1 female patient (2.8%). The average age was 28.8 years (range 13–60 years). Preoperative and postoperative angiographic images were available for review in all patients. The clinical information was introduced into a database including variables referring to epidemiologic data, mechanism of trauma, clinical presentation, topography, morphology of lesions, endovascular techniques used, and angiographic and clinical outcomes.

All procedures were performed under moderate conscious sedation with neuroleptanesthesia allowing regular clinical and neurologic evaluation of the patients. From 2000–2008, double antiplatelet medication with aspirin (325 mg single dose) and clopidogrel (600 mg single dose) was administered before the procedure when treating the common carotid artery (CCA) or internal carotid artery (ICA) (ticlopidine was used instead of clopidogrel before 2000). In cases of bleeding, we started heparinization after hemostasis was achieved. In nonacute cases, we used heparin 70 U/kg after proximal positioning of a 7-F catheter in the compromised vessel. According to the particular requirements of each case, diverse materials and techniques were used, including stent delivery (balloon expandable stents were used before 2003 because they were the only available stents; after 2003, we used only self-expandable stents), embolization, or parent artery occlusion. In all cases of ICA and CCA lesions, we tried a reconstructive approach first. When extensive wall damage was present, it was necessary, however, to sacrifice the parent vessel. In gunshot injuries, the vessel damage usually is severe requiring vessel occlusion. When sacrifice of the carotid artery was unavoidable, a balloon occlusion test was performed for 20 minutes while evaluating for possible neurologic deficits. During balloon occlusion, the collateral circulation was evaluated by injecting the contralateral carotid and the vertebral arteries. The balloon was detached if there were no neurologic deficits, and the collateral circulation was judged adequate.

When treating lesions of the external carotid artery (ECA), angiographic work-up included evaluating the presence of potential anastomotic channels between extracranial and intracranial circulation to avoid inadvertent embolization. In all cases, comparative preembolization and postembolization images were obtained. After the procedure, the patients were taken to the intensive care unit for neurologic and vital sign monitoring.

RESULTS

Clinical Presentation

The causes of the injuries were gunshot wounds in 29 patients (80.6%) and stab wounds in 7 patients (19.4%). Patients most commonly presented with bleeding (n = 14 [38.9%]), followed in frequency by pulsatile mass (n = 7 [19.4%]) and neck bruit (n = 7 [19.4%]) (**Table 1**). Bleeding was more prevalent when the ECA was injured; bleeding was the clinical presentation in 80% of the lesions of the ECA. The remaining patients presented with hematoma (n = 4 [11.1%]), stroke secondary to embolism to the middle cerebral artery (MCA) (n = 3 [8.3%]), and dementia syndrome secondary to intracranial venous hypertension from reflux of a carotid-jugular AVF (n = 1 [2.8%]).

Table 1. Clinical Presentation and Angiographic Findings of Penetrating Lesions of the Extracranial Carotid Artery

	N = 36	%
Mechanism of trauma		
Gunshot	29	80.6%
Stab wound	7	19.4%
Presentation		
Bleeding	14	38.9%
Pulsatile mass	7	19.4%
Neck bruit	7	19.4%
Hematoma	4	11.1%
Stroke	3	8.3%
Dementia syndrome	1	2.8%
Injured vessel		
ECA	15	41.7%
ICA	14	38.9%
CCA	7	19.4%
Type of lesion		
Pseudoaneurysm	24	66.7%
Carotid-jugular AVF	7	19.4%
Dissection	4	11.1%
Active bleeding	1	2.8%

Location and Type of Injury

Of patients, 24 (66.7%) had pseudoaneurysms, 7 (19.4%) had carotid-jugular AVF, 4 (11.1%) had dissections, and 1 (2.8%) had active bleeding. The lesions were found on the following portions of the extracranial carotid artery: the ECA in 15 (41.7%), the ICA in 14 (38.9%), and the CCA in 7 (19.4%). The most frequently affected branch of the ECA was the internal maxillary artery (IMA) in eight (53.3%) cases, followed by the facial artery in three (8.3%) cases.

Endovascular Techniques

Endovascular treatment was performed using diverse techniques and materials (**Table 2**). The CCA and ICA were reconstructed in 76.2% of the cases and sacrificed in the remaining cases (23.8%). The ECA branches were sacrificed in most cases (93.3%). When a reconstructive endovascular approach was used (n = 16), a noncovered stent was deployed in 9 cases (56.2%), and a covered stent was deployed in 7 cases (43.8%). One patient with a lesion of the IMA experienced dissection of the vessel during micro-