ORIGINAL ARTICLE

Experience of a single center in the conservative approach of 20 consecutive cases of asymptomatic extracranial carotid artery aneurysms

V. E. C. Pourier[a], J. C. Welleweerd[a], L. J. Kappelle[b], G. J. E. Rinkel[b], Y. M. Ruigrok[b], H. B. van der Worp[b], T. H. Lo[c], M. L. Bots[d], F. L. Moll[a] and G. J. de Borst[a]

[a]*Department of Vascular Surgery, University Medical Center Utrecht, Utrecht;* [b]*Brain Center Rudolf Magnus, Department of Neurology and Neurosurgery, University Medical Center Utrecht, Utrecht;* [c]*Department of Radiology, University Medical Center Utrecht, Utrecht; and* [d]*Julius Center for Health Sciences and Primary Care, University Medical Center Utrecht, Utrecht, The Netherlands*

Keywords: aneurysm, asymptomatic, carotid artery, conservative, extracranial

Received 10 January 2018
Accepted 3 May 2018

European Journal of Neurology 2018, **25:** 1285–1289

doi:10.1111/ene.13720

Background and purpose: The clinical course and optimal treatment strategy for asymptomatic extracranial carotid artery aneurysms (ECAAs) are unknown. We report our single-center experience with conservative management of patients with an asymptomatic ECAA.

Methods: A search in our hospital records from 1998 to 2013 revealed 20 patients [mean age 52 (SD 12.5) years] with 23 ECAAs, defined as a 150% or more fusiform dilation or any saccular dilatation compared with the healthy internal carotid artery. None of the aneurysms were treated and we had no pre-defined follow-up schedule for these patients. The primary study end-point was the yearly rate for ipsilateral ischemic stroke. Secondary end-points were ipsilateral transient ischemic attack, any stroke-related death, other symptoms related to the aneurysm or growth defined as any diameter increase.

Results: The ECAA was either fusiform (n = 6; mean diameter 10.2 mm) or saccular (n = 17; mean diameter 10.9 mm). Eleven (55%) patients with 13 ECAAs received antithrombotic medication. During follow-up [median 46.5 (range 1–121) months], one patient died due to ipsilateral stroke and the ipsilateral cerebral stroke rate was 1.1 per 100 patient-years (95% confidence interval, 0.01–6.3). Three patients had ECAA growth, two of whom were asymptomatic and one was the patient who suffered a stroke.

Conclusions: In this retrospective case series of patients with an asymptomatic ECAA, the risk of cerebral infarction is small but not negligible. Conservative management seems justified, in particular in patients without growth. Large prospective registry data are necessary to assess follow-up imaging strategies and the role of antiplatelet therapy.

Introduction

Extracranial carotid artery aneurysms (ECAAs) are rare. Just over 1000 cases with ECAA have been reported in the world literature thus far [1]. The etiology is diverse and ranges from atherosclerosis, infection and granulomatous disease to (traumatic) dissection [2]. Most ECAAs are asymptomatic and are a coincidental finding during imaging for alternative pathologies. However, ECAAs may progress into a pulsatile mass or cranial nerve compression, or cause a stroke [3–5].

Little is known about the natural history. Previous studies that included aneurysms with different causes have reported the natural course of ECAA with a combined stroke and mortality rate of >50%, suggesting a low threshold for invasive treatment [6–8]. A recent systematic review reported lack of growth during follow-up or even shrinkage of post-carotid artery dissection aneurysms, suggesting that a conservative approach is justified for these aneurysms [9]. However,

Correspondence: G. J. de Borst, Department of Vascular Surgery, University Medical Center Utrecht, G04.129, PO Box 85500, 3508 GA Utrecht, The Netherlands (tel.: +31 88 7556965; fax: +31 88 755 5017; e-mail: G.J.deBorst-2@umcutrecht.nl).

the studies included in this review consisted of symptomatic and asymptomatic patients, with no data on aneurysm size or growth, or on the interval of imaging follow-up [9]. With the lack of data on the natural course of asymptomatic ECAA, we aimed to assess, in a single-center series, the outcome of patients with asymptomatic ECAA receiving conservative treatment and follow-up.

Methods

Patients

Based on hospital record search, we analyzed a series of 20 patients, either referred for ECAA or with ECAA as a coincidental imaging finding in our tertiary vascular referral and stroke center within the University Medical Center Utrecht, The Netherlands, between January 1998 and December 2013. Patients with at least one follow-up visit at the outpatient clinic were included. Data on patient characteristics, aneurysm characteristics, intervention and short- and long-term outcomes were collected from patient records using a pre-specified form. Patients were considered asymptomatic if they experienced no neurological events in the 6 months prior to presentation. In patients with bilateral ECAA of which one side was previously symptomatic, only the asymptomatic side was included for analysis. The study was approved by the medical ethical committee of the University Medical Center Utrecht. According to local regulations, no informed consent was needed to perform this retrospective study. We performed this study after approval from the medical ethics committee.

Extracranial carotid artery aneurysms

An ECAA was defined as a 150% or more fusiform dilatation of the normal vessel diameter or (saccular) distended sac of any size. For the present analysis, the ECAA had to be in the internal carotid artery (ICA) between the carotid bifurcation and the carotid siphon at the skull base (Figs 1 and 2).

Outcome

Follow-up was performed on a personalized basis, without a pre-defined scheme. The primary outcome was ipsilateral ischemic stroke. Secondary outcomes were ipsilateral transient ischemic attack, any stroke-related death (including major bleeding), growth or any possible aneurysm-related symptoms other than stroke observed during follow-up. Symptoms considered to be aneurysm-related were local cervical pain or sensory sensations (due to a palpable mass in the neck), ipsilateral cranial nerve dysfunction (including hoarseness and dysphagia) or aneurysm rupture. Growth was defined as any diameter increase and was determined by comparing the measured diameters in the radiology reports.

Statistical analysis

For continuous variables, means, median and SD or medians and ranges were calculated. For categorical variables, absolute numbers and/or percentages were calculated. We calculated the stroke rate, the rate for the secondary outcomes and corresponding 95% confidence intervals.

Results

Patients

We included 20 patients; their characteristics and risk factors are presented in Table 1. Eight patients had bilateral ECAAs, of whom five were symptomatic; thus, a total of 23 asymptomatic ECAAs remained. The diagnosis was established on imaging by computed tomography angiography in eight patients, magnetic resonance imaging in six or digital subtraction angiography in one. The median follow-up of patients

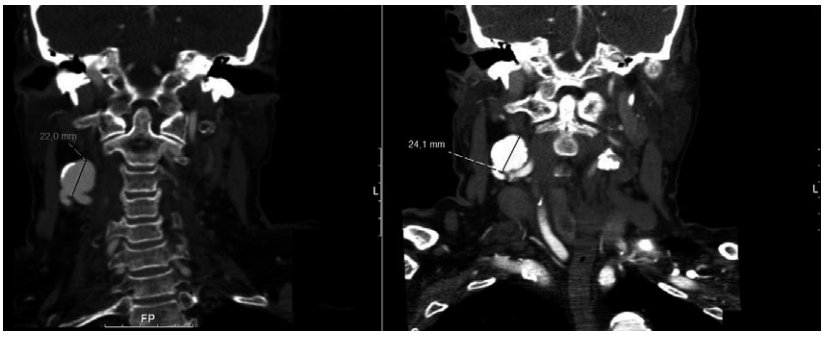

Figure 1 Progression of extracranial carotid artery aneurysms over time.

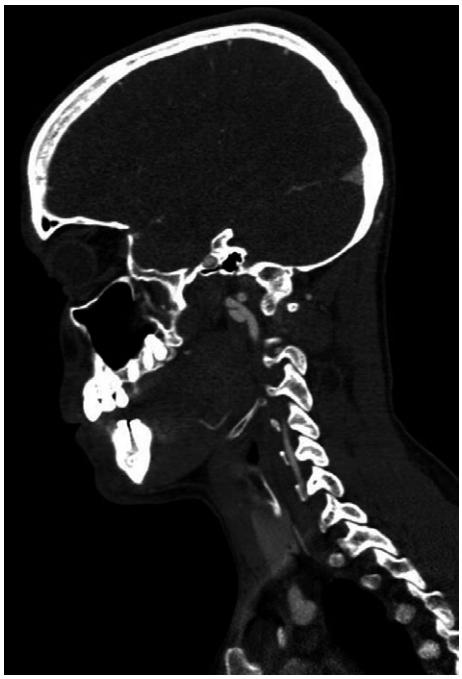

Figure 2 Saccular aneurysm.

was 46.5 (range 1–121) months, within a total of 53 computed tomography angiography, 10 magnetic resonance angiography, 20 duplex ultrasound and three digital subtraction angiography in two patients [one digital subtraction angiography due to a transient ischemic attack at a contralateral (ECAA) side and one after coiling of an caroticovenous fistula, also on the contralateral side]. Patient treatment and the follow-up regimen were determined by the treating physician after a multidisciplinary conference and were based on symptoms, growth and the size of the ECAA.

Characteristics of extracranial carotid artery aneurysms

A total of 17 aneurysms were saccular and 16 were localized in the distal ICA (Table 2). The mean diameter of the saccular aneurysms was 10.9 (range 4–31) mm and that of the fusiform aneurysms was 10.2 (range 8–13.4) mm. Five of the 23 included ECAAs were discovered in patients during follow-up after initial presentation with a symptomatic ECAA on the contralateral side ($n = 3$ after dissection). Three of these contralateral symptomatic ECAAs were treated surgically, one received antiplatelet therapy and the other did not receive any medical or surgical treatment. The other ECAAs were discovered during neurological follow-up after contralateral hemorrhagic or ischemic stroke, screening for suspicion for transient ischemic attack, follow-up of connective tissue disease or as a coincidental finding.

Table 1 Patient characteristics, risk factors and clinical presentation

	No. of patients ($n = 20$)	Percentage
Male	14	70
Mean age (years)	52.2	
Hypertension	12	60
COPD	0	0
Hyperlipidemia	6	30
Smoking		
Current smoker	4	20
Previous smoker	6	30
Diabetes mellitus	1	5
Coronary heart disease	3	15
Peripheral arterial disease	1	5
Non-cerebrovascular aneurysms	3	15
Clinical presentation		
Coincidental finding	8	40
Neurological symptoms	10	50
Follow-up connective tissue disease	2	10

COPD, chronic obstructive pulmonary disease.

Table 2 Aneurysm characteristics

	No. of aneurysms ($n = 23$)	Percentage
Side		
Left	10	43.5
Location		
Distal ICA	16	69.6
Proximal ICA	7	30.4
Shape		
Saccular	17	74
Fusiform	6	26
Size (mm) [mean (range)]		26
Saccular	10.9 (4–31)	
Fusiform	10.2 (8–13.4)	

ICA, internal carotid artery.

Outcome

During follow-up, one patient with an initial 20-mm saccular aneurysm of the left ICA and no antiplatelet or anticoagulant medication was advised to undergo surgical resection because of identified growth to a diameter of 24 mm in 8 months but she declined. This patient was admitted to hospital because of a stroke in the posterior circulation 13 months after the initial ECAA diagnosis. During admission, this patient had an additional major stroke in the cerebral territory of the ipsilateral middle cerebral artery, which was eventually fatal. The electrocardiogram showed atrial fibrillation and computed tomography angiography showed thrombosis of the entire middle cerebral artery and ICA distal to the aneurysm. The calculated

ipsilateral cerebral stroke rate was 1.1 per 100 patient-years (95% confidence interval, 0.014–6.28).

Two other patients had an asymptomatic aneurysm growth resulting in a growth rate of 3.4 per 100 patient-years (95% confidence interval, 0.9–9.2). One patient with a saccular aneurysm (initially 12 mm; during follow-up after 59 months, 16 mm) of the right distal ICA underwent a combined surgical and endovascular procedure with a bare metal stent. The patient was asymptomatic during the entire 75-month follow-up period after surgery. The third patient with a fusiform ECAA with growth of the right distal ICA (initially 8 mm; during follow-up over 57 months, 9 mm) remained asymptomatic with conservative treatment. Two patients died during follow-up from causes unrelated to an ECAA and all other patients remained asymptomatic during follow-up.

Discussion

This case series of 20 consecutive patients with 23 ECAAs shows that one patient had a fatal cerebral infarction in the territory of the affected carotid artery during follow-up although initially having an asymptomatic ECAA. This patient also had atrial fibrillation, indicating another possible cause of the stroke. Two other patients also had growth of their asymptomatic ECAA, whereas only one was treated endovascularly.

This current study, as far as we know, is the largest study reporting experiences of conservative management of specifically asymptomatic ECAA [1]. Another study reporting 10 cases of asymptomatic ECAA treated conservatively reported a benign clinical course of asymptomatic dissection aneurysm [10].

The low stroke and mortality rate that we found for conservative management of ECAA is also in agreement with another publication on conservative management in ECAA, which described a series of patients with dissecting aneurysms [9]. The majority of the dissecting aneurysms remained asymptomatic and did not increase in size, whereas some even spontaneously resolved [9]. Another study also reports a low aneurysm-related death rate in the non-operatively treated group. However, all of the studies that we found included symptomatic and asymptomatic patients [9–11].

The previously suggested high stroke and mortality rate is mainly derived from literature that dates back to between one and more than three decades ago [6,7]. On the basis of this suggested high mortality and morbidity rate, many aneurysms of the extracranial carotid artery have been treated invasively. It must be noted that this rate included aneurysms of all etiology and included mycotic, symptomatic and growing aneurysms. Furthermore, these patients were not treated with anticoagulant or antiplatelet medication, which is currently a well-accepted preventive therapy for cardiovascular events, although not proven to be effective in patients with ECAA [12].

It must be noted that the stroke rate might be even less than the one that we found, as the stroke observed in our study was probably caused by cardiac embolism due to atrial fibrillation.

This study has limitations. First, because of the retrospective character, there was no standardized follow-up schedule, which may have led to missing data regarding aneurysm and patient characteristics. Also, in some cases, the physician ceased the follow-up for unknown reasons. Secondly, there is selection bias. The sample in this study consists of patients in whom the treating physician selected a treatment strategy based on the patient's clinical presentation and aneurysm characteristics. This is due to a lack of guidelines for medical treatment. Finally, this study contains a group of patients with different etiology. However, this case series offers a large series with a relatively long-term follow-up and provides additional insights into the prognosis of ECAA in asymptomatic patients. A larger prospective registry-based patient population further analyzing the natural course of ECAA in asymptomatic patients is clearly needed to substantiate treatment guidelines [13]. Medical therapy for ECAA that has so far been unexplored also needs to be investigated further.

Conclusions

In conclusion, this retrospective single-center study showed that patients with an asymptomatic ECAA have a rate of ischemic stroke in the aneurysm territory of 1.1 per 100 patient-years. Most aneurysms do not grow over time and remain asymptomatic. Large-scale data reporting long-term natural follow-up are warranted.

Disclosure of conflicts of interest

The authors declare no financial or other conflicts of interest.

References

1. Welleweerd JC, den Ruijter HM, Nelissen BGL, *et al.* Management of extracranial carotid artery aneurysm. *Eur J Vasc Endovasc Surg* 2015; **50:** 141–147.
2. Welleweerd JC, Nelissen BGL, Koole D, *et al.* Histological analysis of extracranial carotid artery aneurysms. *PLoS ONE* 2015; **10:** e0117915.
3. De Jong KP, Zondervan PE, Van Urk H. Extracranial carotid artery aneurysms. *Eur J Vasc Surg* 1989; **3:** 557–562.

4. McCollum CH, Wheeler WG, Noon GP, DeBakey ME. Aneurysms of the extracranial carotid artery: twenty-one years' experience. *Am J Surg* 1979; **137:** 196–200.
5. Radak D, Davidovic L, Vukobratov V, *et al*. Carotid artery aneurysms: Serbian multicentric study. *Ann Vasc Surg* 2007; **21:** 23–29.
6. El-Sabrout R, Cooley DA. Extracranial carotid artery aneurysms: Texas Heart Institute experience. *J Vasc Surg* 2000; **31:** 702–712.
7. Zwolak RM, Whitehouse WM Jr, Knake JE, *et al*. Atherosclerotic extracranial carotid artery aneurysms. *J Vasc Surg* 1984; **1:** 415–422.
8. Nathan Winslow M. Extracranial aneurysm of the internal carotid artery: history and analysis of the cases registered up to August 1, 1925. *Arch Surg* 1926; **13:** 689–729.
9. Paraskevas KI, Batchelder AJ, Naylor AR. Fate of distal false aneurysms complicating internal carotid artery dissection: a systematic review. *Eur J Vasc Endovasc Surg* 2016; **52:** 281–286.
10. Frankhauser GT, Stone WM, Fowl RJ, *et al*. Surgical and medical management of extracranial carotid artery aneuryms. *J Vasc Surg* 2015; **61:** 389–393.
11. Touze E, Randoux B, Meary E, *et al*. Aneurysmal forms of cervical artery dissection, associated factors and outcome. *Stroke* 2001; **32:** 418–423.
12. Antithrombotic Trialists' Collaboration. Collaborative meta-analysis of randomised trials of antiplatelet therapy for prevention of death, myocardial infarction, and stroke in high risk patients. *BMJ* 2002; **324:** 71–86.
13. Welleweerd JC, Bots ML, Kappelle LJ, *et al*. Rationale and design of the extracranial carotid artery aneurysm registry (CAR). *J Cardiovasc Surg (Torino)* 2015. [Epub ahead of print].