UNIVERSITÀ DEGLI STUDI FIRENZE

FLORE
Repository istituzionale dell'Università degli Studi di Firenze

Carotid endarterectomy in patients with acute neurological symptoms: a case control study

Questa è la Versione finale referata (Post print/Accepted manuscript) della seguente pubblicazione:

Original Citation:

Carotid endarterectomy in patients with acute neurological symptoms: a case control study / W. Dorigo, R. Pulli , E. Barbanti , L. Azas, N. Troisi, G. Pratesi, A. Alessi Innocenti, C. Pratesi. - In: INTERACTIVE CARDIOVASCULAR AND THORACIC SURGERY. - ISSN 1569-9293. - STAMPA. - 6:(2007), pp. 369-373.

Availability:

The webpage https://hdl.handle.net/2158/605449 of the repository was last updated on 2020-05-14T22:14:39Z

Terms of use:

Open Access

La pubblicazione è resa disponibile sotto le norme e i termini della licenza di deposito, secondo quanto stabilito dalla Policy per l'accesso aperto dell'Università degli Studi di Firenze (https://www.sba.unifi.it/upload/policy-oa-2016-1.pdf)

Publisher copyright claim:

La data sopra indicata si riferisce all'ultimo aggiornamento della scheda del Repository FloRe - The above-mentioned date refers to the last update of the record in the Institutional Repository FloRe

(Article begins on next page)

05 September 2026

Interactive CardioVascular and Thoracic Surgery

Carotid endarterectomy in patients with acute neurological symptoms: a case-control study

Walter Dorigo, Raffaele Pulli, Enrico Barbanti, Leonidas Azas, Nicola Troisi, Giovanni Pratesi, Alessandro AlessiInnocenti and Carlo Pratesi

Interact CardioVasc Thorac Surg 2007;6:369-373; originally published online Feb 9, 2007;
DOI: 10.1510/icvts.2006.137547

The online version of this article, along with updated information and services, is located on the World Wide Web at:
http://icvts.ctsnetjournals.org/cgi/content/full/6/3/369

Interactive Cardiovascular and Thoracic Surgery is the official journal of the European Association for Cardio-thoracic Surgery (EACTS) and the European Society for Cardiovascular Surgery (ESCVS). Copyright © 2007 by European Association for Cardio-thoracic Surgery. Print ISSN: 1569-9293.

Downloaded from icvts.ctsnetjournals.org by on July 17, 2008

doi:10.1510/icvts.2006.137547

INTERACTIVE CARDIOVASCULAR AND THORACIC SURGERY

Interactive CardioVascular and Thoracic Surgery 6 (2007) 369–373

www.icvts.org

ESCVS article - Vascular thoracic

Carotid endarterectomy in patients with acute neurological symptoms: a case-control study☆

Walter Dorigo*, Raffaele Pulli, Enrico Barbanti, Leonidas Azas, Nicola Troisi, Giovanni Pratesi, Alessandro Alessi Innocenti, Carlo Pratesi

Department of Vascular Surgery, University of Florence, Viale Morgagni 85, 50134, Florence, Italy

Received 31 May 2006; received in revised form 15 January 2007; accepted 22 January 2007

Abstract

Objective: The aim of this study was to retrospectively evaluate our experience in urgent carotid endarterectomy (CEA) in patients with acute neurological symptoms comparing them with results obtained in stable symptomatic patients in a case-control study. **Materials and methods:** From January 1996 to December 2005, 3336 consecutive CEAs were performed at our department. In 70 cases CEA was carried out in patients with acute neurological deficit; in all these patients, clinical presentations were recent (<24 h) or crescendo (defined as two or more episodes in 24 h, with complete recovery after each episode) TIAs (group 1). The control group was randomly obtained from our historical database and consisted of 352 stable symptomatic patients operated on in the same period (group 2). Early (30-day) results in the two groups were compared by χ^2 and Fisher exact tests; follow-up data were analysed by life-table analysis (Kaplan–Meier test) and results in subgroups were compared by means of log-rank test. **Results:** Considering mortality and any neurological morbidity, the patients of group 1 showed a cumulative rate of death and neurological complication significantly higher than those in group 2 (5.4% and 0.3%, respectively; $P=0.005$); however, when analysing 30-day disabling strokes and deaths, the patients of group 1 had a cumulative complication rate of 1.4%, whereas in group 2 the corresponding figure was 0.3% (P=n.s.). In patients of group 1, univariate analysis and logistic regression for multivariate analysis for 30-day risk of stroke and death did not show any influence of comorbidities, clinical status, anatomical and surgical features. Estimated cumulative 36-month survival was significantly better in group 2 than in group 1. Considering the absence of ipsilateral stroke at 36 months, there were no differences between the two groups; however, analysing the estimated absence of any neurological events, both ipsilateral and contralateral, at 36 months, patients of group 1 had a higher risk than those of group 2. **Conclusions:** Urgent CEA in patients with recent/crescendo TIA and appropriate carotid artery lesion, carries good early and long-term results, which, however, remain slightly poorer than those obtained in symptomatic patients with a stable neurological status.
© 2007 Published by European Association for Cardio-Thoracic Surgery. All rights reserved.

Keywords: Carotid endarterectomy; Acute stroke; Crescendo TIA; Unstable neurological status

1. Introduction

Carotid endarterectomy (CEA) is a well-accepted method for stroke prevention both in patients with moderate or severe symptomatic carotid artery stenosis and in patients with severe asymptomatic stenoses [1–3].

However, there is no evidence concerning the benefit of CEA in patients with unstable neurological symptoms, depending on the lack of studies designed to evaluate this subgroup of patients, presenting with different clinical symptoms, instrumental features and anatomical characteristics, all comprised into the definition of 'patient with acute neurological deficit'.

Recent or crescendo transient ischaemic attack (TIA), stroke in evolution and acute stroke are considered emergent conditions under a neurological point of view; in some of these clinical situations urgent CEA can be indicated. Recent guidelines [4] stated that surgical treatment should be considered feasible only in the presence of appropriate carotid lesion, such as severe stenosis, near-occlusion, acute thrombosis, presence of floating thrombus into the lumen.

In spite of these concepts, several unsolved problems and unclear points are still present, mainly related to the definition of criteria for the selection of the patient with acute neurological deficit supposed to have some benefits from CEA, with a low rate of complications in perioperative period.

The aim of this study was to retrospectively evaluate our experience in urgent CEA in patients with acute neurological symptoms comparing them with those obtained in stable symptomatic patients in a case-control study.

2. Materials and methods

From January 1996 to December 2005, 3336 consecutive CEAs were performed at our department; data concerning these interventions were collected and prospectively

☆ Presented at the 55th International Congress of the European Society for Cardiovascular Surgery, St Petersburg, Russian Federation, May 11–14, 2006.

*Corresponding author. Tel.: +39 055412029; fax: +39 0554220133.
E-mail address: dorigow@unifi.it (W. Dorigo).

© 2007 Published by European Association for Cardio-Thoracic Surgery

Downloaded from icvts.ctsnetjournals.org by on July 17, 2008

inserted in a dedicated database, containing 150 fields concerning main anatomical, clinical, instrumental and technical variables. This database also contains early and 30-day results in terms of mortality and neurological morbidity and all the clinical and instrumental data collected during follow-up.

In the examined period, 1223 CEAs were performed in patients with symptomatic carotid artery stenosis; patients were defined symptomatic if they suffered at least a TIA episode in the six months prior to the intervention or if they showed cerebral lesions dependent on operated carotid artery at preoperative computed tomography (CT) scan.

In 70 cases CEA was carried out in patients with acute neurological deficit; in all these patients, the clinical presentations were recent ($<$24 h) or crescendo (defined as two or more episodes in 24 h, with complete recovery after each episode) TIAs (group 1). The control group was randomly obtained from our historical database and consisted of 352 stable symptomatic patients operated on in the same period (group 2).

All the patients underwent preoperative duplex-scanning of extracranial vessels and angio-computed tomography (CT) scan or digital subtraction angiography (DSA) in double projection for the evaluation of cerebral parenchyma and supra-aortic vessels. Degree of stenosis was determined by means of the NASCET method [1]. The status of vertebral arteries and of intracranial vessels was also examined during the preoperative assessment with angiography or angio-CT scan.

All the patients were preoperatively visited by a consultant neurologist; in patients with acute neurological symptoms, the presence of alterated consciousness, deep or fixed neurological deficit, middle cerebral artery occlusion or ischaemic lesions $>$1 cm at CT scan were considered as a contraindication for surgical intervention. Patients not selected for surgery were admitted to the stroke unit and then medically treated. Patients selected for surgery were operated on within 24 h from the last symptom.

All the interventions were performed under general anaesthesia: somatosensory evoked potentials (SEPs) were used to monitor cerebral status during surgical intervention and to indicate when the use of shunt was necessary. Criterion for shunt insertion was defined as a reduction of N20/P25 waves higher than 75% of baseline values [5]. Surgical strategy consisted of preliminary isolation and clamping of the distal internal carotid artery [6]. Standard longitudinal endarterectomy with a wide exposure of the proximal and distal limits of the plaque was then carried out. A policy of selective patching for carotid reconstruction on the basis of age, sex, size of internal carotid artery and distal extension of the plaque was used. At the end of intervention, completion study with digital subtraction angiography in double projection was routinely performed in acute patients. At discharge all the patients underwent a new neurological examination performed by a consultant neurologist. New central neurological focal events (TIA, minor stroke, major stroke) were assessed.

Clinical and ultrasonographic follow-up was performed at 1, 6 and 12 months and then once a year. All studies were performed using the Acuson Sequoia 512 Ultrasound System (Acuson Corporation, Mountain View, CA). A 8L5 linear array probe with an operating frequency of 8.0–5.0 MHz was used in all the cases.

Early (30-day) results in the two groups were compared by χ^2 and Fisher exact tests; moreover, logistic regression for multivariate analysis was used for evaluation of 30-day stroke and mortality risks (SPSS 10.0 program for Windows; SPSS Inc., Chicago, IL). Follow-up data were analysed by life-table analysis (Kaplan–Meier test) and results in subgroups were compared by means of log rank test.

3. Results

There were no differences between the two groups in terms of age, comorbidities and common risk factors for atherosclerosis, except for a higher prevalence of coronary artery disease and diabetes mellitus in group 1 (Table 1). Considering degree of stenosis on the operated site, patients in group 1 had a significantly higher incidence of 80% stenosis than in group 2; moreover, in patients of group 1 a higher prevalence of near-occlusion was detected (Table 2). There were no differences between the two groups regarding contralateral preoperative neurological symptoms and degree of stenosis.

In group 1 there was a significant higher incidence of shunt insertion than in group 2 (Table 3); this was due both to a significant incidence of SEPs reduction at clamping and to a different adopted strategy (a higher number of shunts routinely applied in the patient with acute neurological deficit). There were no significant differences regarding carotid reconstruction, with a wide use of patch in both groups (70% in group 1 vs. 65% in group 2).

Early and 30-day results are shown in Table 4.

Considering mortality and any neurological morbidity, the patients of group 1 showed a cumulative rate of death and neurological complication significantly higher than those in

Table 1
General patient characteristics

	Group 1	Group 2	*P*
Median age	73	74	n.s.
Coronary artery disease	23 (32.8%)	54 (18.4%)	0.05
Peripheral artery disease	19 (27.5%)	110 (31.2%)	n.s.
Hypertension	39 (55.5%)	213 (60.1%)	n.s.
Hyperlipidaemia	38 (54.2%)	195 (55.3%)	n.s.
Diabetes mellitus	21 (30%)	70 (19.8%)	0.05

Table 2
Degree of stenosis on the operated site

	Group 1	Group 2	*P*
Stenosis 60–80%	13 (18.5%)	134 (38%)	0.02
Stenosis 80–99%	49 (70%)	210 (58.5%)	0.06
Near-occlusion	8 (11.5%)	8 (2.2%)	0.001

Table 3
Intraoperative cerebral status monitoring and shunt insertion

	Group 1	Group 2	*P*
SEPs reduction	8 (11.5%)	25 (7%)	0.02
Routinely applied shunt	17 (24.2%)	11 (3.1%)	$<$0.001
Total number of shunts	25 (35.7%)	36 (10.2%)	$<$0.001

Downloaded from icvts.ctsnetjournals.org by on July 17, 2008

Table 4
Early and 30-day results

	Group 1	Group 2	*P*
Neurological deficits at wakening	3 (4%)	0	<0.001
30-day minor stroke	3 (4%)	0	<0.001
30-day major stroke	0	0	n.s.
Death	1 (1.4%)	1 (0.3%)	n.s.

group 2 (5.4% and 0.3%, respectively); however, when analysing 30-day disabling strokes and deaths, the patients of group 1 had a cumulative complication rate of 1.4%, whereas in group 2 the corresponding figure was 0.3%. The only death in group 1 was due to a myocardial infarction, occurring on the 3rd postoperative day in a woman who underwent urgent CEA for crescendo TIAs.

In patients of group 1, univariate analysis and logistic regression for multivariate analysis for 30-day risk of stroke and death did not show any influence of the examined parameters (sex, age, diabetes, arterial hypertension, coronary artery disease, hyperlipidaemia, contralateral carotid artery occlusion, shunt insertion, kind of reconstruction).

Follow-up was performed in 368 patients (88%), with a mean duration of 24 months (range 1–108). During follow-up there were 13 deaths (five in group 1 and eight in the other group) and seven ipsilateral neurological events.

Estimated cumulative 36-month survival was significantly better in group 2 than in group 1 (97% and 91%, respectively; $P=0.03$, log-rank 4.4; Fig. 1).

Considering the absence of ipsilateral stroke at 36 months, there were no differences between the two groups (100% in group 1 and 99% in group 2; $P=0.6$, log-rank 0.22); however, analysing the estimated absence of any neurological events, both ipsilateral and contralateral, at 36 months, patients of group 1 had a higher risk than those of group 2 (88% in group 1, and 97% in group 2; $P=0.006$, log-rank 11.7; Fig. 2).

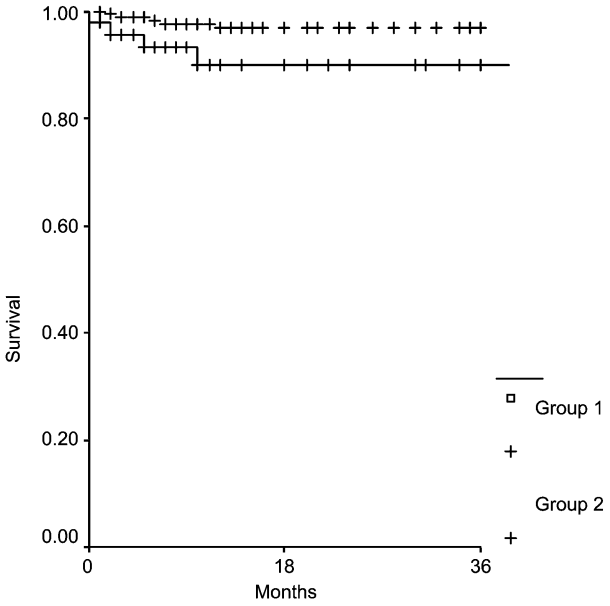
Moreover, there were no differences between the two groups in terms of 60% restenosis at 36 months (9% in group 1 and 10% in group 2; $P=0.1$, log-rank 2.2).

In patients of group 1, univariate analysis for the risk of ipsi- or contralateral neurological events during the follow-up did not show any correlation between the examined parameters (sex, age, diabetes, arterial hypertension, coronary artery disease, hyperlipidaemia, contralateral carotid occlusion, shunt insertion, kind of reconstruction) and long-term neurological events (Table 5).

4. Discussion

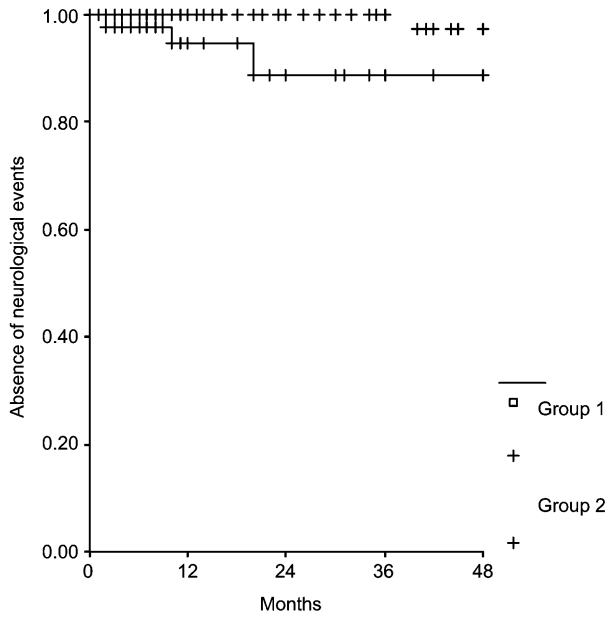
The first experiences in the treatment of 'acute' carotid artery stenosis were described in the early 1960s and were characterised by poor results, mainly due to postoperative intracranial haemorrhage [7–9]. As a consequence, in the following 20 years the avoidance of urgent CEA was commonly accepted worldwide and the intervention was generally delayed for up to six weeks after the clinical event [10].

In recent years, however, significant improvements in medical, surgical and anaesthesiological techniques, and the creation of territorial care networks for the treatment



Months	0	12	24	36
Group 1	56	31	16	7
Group 2	312	201	125	75

Fig. 1. Estimated cumulated 36-month survival in the two groups with number of patients at risk.



Months	0	12	24	36
Group 1	56	30	17	7
Group 2	312	197	119	67

Fig. 2. Estimated absence of any neurological events in the two groups during the follow-up with the number of patients at risk.

Downloaded from icvts.ctsnetjournals.org by on July 17, 2008

Table 5
Univariate analysis for neurological morbidity risk during follow-up in patients of group 1

	Kaplan–Meier % at 2 years	Log-rank	P
Age			
->79 years	100	0.30	0.5
-<79 years	88		
Sex			
-Male	90	0.45	0.5
-Female	80		
Patch closure			
-Yes	86	0.13	0.9
-No	92		
Shunt insertion			
-Yes	86	1.1	0.7
-No	80		
Coronary artery disease			
-Yes	100	0.8	0.3
-No	93		
Arterial hypertension			
-Yes	100	1.1	0.2
-No	90		
Diabetes mellitus			
-Yes	100	1.8	0.1
-No	88		
Contralateral occlusion			
-Yes	100	0.5	0.8
-No	88		

of acute stroke has determined a new rising interest for the surgical treatment of patients with unstable neurological symptoms.

Particularly in the presence of recent or crescendo TIA, the role of surgical intervention seems to be really basic. TIA represents a substantial signal of danger for further, severe neurological events, with a risk of stroke of 5% in the first 48 h and of 10% within three months [11]; in patients with severe or moderate carotid stenosis on the affected hemisphere, the risk rises up to 6% in the first 48 h and to 20% within three months [12], and becomes even higher in the presence of crescendo TIAs, defined as two or more episodes in 24 h, with complete recovery after each episode [13].

On the basis of these data, the indication for urgent CEA in patients with recent/crescendo TIAs seems to be mandatory, also considering that, in most patients, the ischaemic episode is caused by a tight, unstable stenosis, with morphologic features of high-risk for intracranial embolisation, and that intracranial vessels are usually patent with no new cerebral lesions on CT examination. These were also our criteria of feasibility for surgical intervention, similar to those adopted in main clinical studies, which report good results of surgery in these selected subgroup of patients at high-risk for early recurrent neurological events [14–16].

As a consequence, the most recent Italian guidelines [4] recommend urgent TEA in patients with recent (<24 h)/crescendo TIA and severe carotid artery stenosis in experienced centres, with documented low complication rates in elective surgical treatment of extracranial carotid artery disease.

Also in our experience, results were fairly good, with no major strokes at 30 days; as expected, cumulative complication rate was significantly higher in the study group than in control group. These results suggest that acute carotid artery stenosis can be considered an end-stage atherosclerotic disease, and this hypothesis is confirmed by the significant differences between the two groups in terms of cardiovascular comorbidities and of severity of carotid stenosis. However, the aggressive medical treatment of cardiovascular disease and risk factors in our patients (statins, ACE inhibitors, β-blockers and antiplatelet drugs) allowed us to have a low rate of mortality and neurological events in patients with multiple cardiovascular disease (coronary artery disease, hypertension, diabetes). We had a higher shunt insertion rate in our experience, due both to surgeon's choice and to decreased tolerance to carotid clamping in our patients, which, however, did not affect our results. There were no postoperative intracranial haemorrhages, and it could be explained by the careful preoperative diagnostic assessment of patients and particularly by the evaluation of the status of cerebral parenchyma, with the exclusion from the intervention of patients with large (1 cm) new ischaemic areas [17, 18].

We performed a routine intraoperative completion study with DSA in all acute patients; in our experience, the use of routine DSA is not mandatory [19], but it is limited to selected patients (patients who had shunt insertion, in the presence of reintervention or carotid near-occlusion, when the surgeon uses a technique which he is not familiar with). Acute patients can be considered a subgroup requiring a careful intraoperative control, with evaluation of intracranial vessels' status. In recent years, the use of duplex scanning has been proposed as an alternative or adjunctive method for intraoperative completion study. Particularly in the detection of minor technical defects after CEA [20], duplex scanning has been reported to be more accurate than carotid angiography, and its routine use has been proposed; however, in acute patients DSA remains in our opinion worthwhile, due to the good visualisation of intracranial vessels.

We analysed also long-term results, and we are not aware of any previous study describing the fate of acute patients during follow-up. There were no significant differences between study group and control group in terms of ipsilateral neurological events during follow-up, confirming the long-term effectiveness of CEA; however, in the study group long-term survival and any (ipsi- and contralateral) neurological event-free rates were significantly lower than in the control group, thus reflecting the severity of atherosclerotic disease in these subgroups of patients.

There are no data in Literature concerning the use of carotid angioplasty and stenting (CAS) in patients with acute symptoms; recent studies [21] failed to demonstrate the non-inferiority of CAS against CEA in stable symptomatic patients, and it is reasonable to assume that results of CAS could be even poorer in the presence of unstable, complicated plaques, which are considered, at the moment, unsuitable for CAS.

In our series only patients without acute stroke were considered as candidates to surgical intervention; in Literature, little information exists about the efficacy of CEA in patients with acute ischaemic stroke, which is considered a high-risk procedure [22, 23]. Some studies reported a significant improvement following surgery among patients

Downloaded from icvts.ctsnetjournals.org by on July 17, 2008

with mild-to-moderate neurological impairment; still, the data are limited and the usefulness of urgent surgery among patients with severe neurological deficits is even less clear, thus contraindicating urgent CEA outside of a research setting [18].

However, encouraging results were reported in some recent studies [24, 25] analysing the effectiveness of urgent CEA in patients with stroke in evolution or fluctuating stroke. These few data in Literature confirm the feasibility of surgery in carefully selected patients, with encouraging results in terms of neurological recovery but no negligible rates of major complications.

5. Conclusions

Urgent CEA in patients with recent/crescendo TIA and appropriate carotid artery lesion seems to substantially modify the natural history of these patients who, if untreated, are at high risk for further, and more severe neurological and cardiovascular events. In these patients urgent CEA carries good early and long-term results, which, however, remain slightly poorer than those obtained in symptomatic patients with a stable neurological status.

For this reason, a careful patient selection, deriving from the close collaboration of different specialists (neurologists, neuroradiologists and vascular surgeons in a multidisciplinary unit), is the basic point in order to improve the results of surgical intervention and to reduce the number and the severity of early and late complications.

References

[1] Rothwell PM, Eliasziw M, Gutnikov SA, Fox AJ, Taylor DW, Mayberg MR, Warlow CP, Barnett HJ, for the Carotid Endarterectomy Trialists' Collaboration. Analysis of pooled data from the randomised controlled trials of endarterectomy for symptomatic carotid stenosis. Lancet 2003;361:107–116.

[2] Biller J, Feinberg WM, Castaldo JE, Whittemore AD, Harbaugh RE, Dempsey RJ, Capaln RL, Kresowik TF, Matchar DB, Toole JF, Easton JD, Adams HP, Brass LM, Hobson RW, Brott TG, Sternau L. Guidelines for carotid endarterectomy: a statement for healthcare professionals from a special writing group of the stroke council, American Heart Association. Stroke 1998;29:554–562.

[3] Executive Committee for the Asymptomatic Carotid Atherosclerosis Study. Endarterectomy for asymptomatic carotid artery stenosis. J Am Med Assoc 1995;273:1421–1429.

[4] Stroke Prevention and Educational Awareness Diffusion (SPREAD). Ischemic stroke: Italian guidelines on prevention and treatment. IV edition. Pubblicazioni Catel. Milano 2005;323–345.

[5] Amantini A, Bartelli M, De Scisciolo G, Lombardi M, Macucci M, Rossi R, Pratesi C, Pinto F. Monitoring of somatosensory evoked potentials during carotid endarterectomy. J Neurol 1992;239:241–247.

[6] Pratesi C, Dorigo W, Alessi A, Azas L, Barbanti E, Lombardi R, Pratesi G, Pulli R. Reducing the risk of intraoperative neurological complications during carotid endarterectomy with early distal control of the internal carotid artery. Eur J Vasc Endovasc Surg 2004;28:670–673.

[7] Wylie EJ, Hein MF, Adams JE. Intracranial haemorrhage following surgical revascularization for treatment of acute strokes. J Neurosurg 1964;21:212–218.

[8] Rob CG. Operation for acute completed stroke due to thrombosis of the internal carotid artery. Surgery 1969;65:862–865.

[9] Blaisdell WF, Clauss RH, Gailbraith JG, Imparato AM, Wylie EJ. Joint study of extracranial arterial occlusion. J Am Med Assoc 1969;209:1889–1895.

[10] Beebe HG. Surgery for acute stroke. Semin Vasc Surg 1995;8:55–62.

[11] Johnston SG, Gress DR, Browner WS, Sidney S. Short term prognosis after emergency department diagnosis of TIA. J Am Med Assoc 2000;284:2901–2906.

[12] Eliasziw M, Kennedy J, Hill MD, Buchan AM, Barnett HJ. Early risk of stroke after a transient ischemic attack in patients with internal carotid artery disease. Can Med Assoc J 2004;170:1105–1109.

[13] Wilson SE, Mayberg MR, Yatsu F, Weiss DG. Crescendo transient ischemic attacks: a surgical imperative. J Vasc Surg 1993;17:249–256.

[14] Schneider C, Johansen K, Koningstein R, Meitzner C, Oettinger W. Emergency carotid thrombendarterectomy: safe and effective. World J Surg 1999;23:1163–1167.

[15] Peiper C, Nowack J, Ktenidis K, Hopstein S, Keresztury G, Horsch S. Prophylactic urgent revascularization of the internal carotid artery in the stmptomatic patients. VASA J Vasc Dis 2001;30:247–251.

[16] Huber R, Muller BT, Seitz RJ, Siebler M, Modder U, Sandmann W. Carotid surgery in acute symptomatic patients. Eur J Vasc Endovasc Surg 2003;25:60–67.

[17] Fiorani P, Sbarigia E, Speziale F, Zaccaria A, Giannoni MF. Indicazioni al trattamento chirurgico nell'ischemia cerebrale acuta. In: Pratesi C, Pulli R, eds. Le carotidopatie extracraniche. Edizioni Minerva Medica, Torino 2002;42–45.

[18] Adams HP Jr, Adams RJ, Brott T, del Zoppo GJ, Furlan A, Goldstein LB, Grubb RL, Higashida R, Kidwell C, Kwiatkowski TG, Marler JR, Hademenos GJ, Stroke Council of the American Stroke Association. Guidelines for early management of patients with ischemic stroke. A scientific statement from the Stroke Council of the American Heart Association. Stroke 2003;34:1056–1083.

[19] Pratesi C, Dorigo W, Troisi N, Fargion A, Alessi Innocenti A, Pratesi G, Barbanti E, Pulli R. Routine completion angiography during carotid endarterectomy is not mandatory. Eur J Vasc Endovasc Surg 2006;3:369–373.

[20] Walker RA, Fox AD, Magee TR, Horrocks M. Intraoperative duplex scanning as a means of quality control during carotid endarterectomy. Eur J Vasc Endovasc Surg 1996;11:364–367.

[21] Mas JL, Chatellier G, Beyssen B, Branchereau A, Moulin T, Becquemin JP, Larrue V, Lievre M, Leys D, Bonneville JF, Watelet J, Pruvo JP, Albucher JF, Viguier A, Piquet P, Garnier P, Viader F, Touze E, Giroud M, Hosseini H, Pillet JC, Favrole P, Neau JP, Ducrocq X, EVA-3S Investigators. Endarterectomy versus stenting in patients with symptomatic severe carotid stenosis. N Engl J Med 2006;355:1660–1671.

[22] Eckstein HH, Schumacher H, Dorfler A, Forsting M, Jansen O, Ringleb P, Allenberg JR. Carotid endarterectomy and intracranial thrombolysis: simultaneous and staged procedures in ischemic stroke. J Vasc Surg 1999;29:459–471.

[23] Eckstein HH, Schumacher H, Klemm K, Laubach H, Kraus T, Ringleb P, Dorfler A, Weigand M, Bardenheuer H, Allenberg JR. Emergency carotid endarterectomy. Cerebrovas Dis 1999;9:270–281.

[24] Brandl R, Brauer RB, Maurer PC. Urgent carotid endarterectomy for stroke in evolution. VASA J Vasc Dis 2001;30:115–121.

[25] Fiorani P, Sbarigia E, Speziale F, Brizzi V, Panico MA, Toni D. Rivascolarizzazione carotidea precoce nei pazienti con ictus in fase acuta: studio prospettico multicentrico non randomizzato. In: Pratesi C, Pulli R, eds. Emergenze Vascolari. Edizioni Minerva Medica, Torino 2004;23–27.

Downloaded from icvts.ctsnetjournals.org by on July 17, 2008

Carotid endarterectomy in patients with acute neurological symptoms: a case-control study

Walter Dorigo, Raffaele Pulli, Enrico Barbanti, Leonidas Azas, Nicola Troisi, Giovanni Pratesi, Alessandro AlessiInnocenti and Carlo Pratesi

Interact CardioVasc Thorac Surg 2007;6:369-373; originally published online Feb 9, 2007;
DOI: 10.1510/icvts.2006.137547

This information is current as of July 17, 2008

Updated Information & Services	including high-resolution figures, can be found at: http://icvts.ctsnetjournals.org/cgi/content/full/6/3/369
References	This article cites 22 articles, 6 of which you can access for free at: http://icvts.ctsnetjournals.org/cgi/content/full/6/3/369#BIBL
Permissions & Licensing	Requests to reproducing this article in parts (figures, tables) or in its entirety should be submitted to: icvts@ejcts.ch
Reprints	For information about ordering reprints, please email: icvts@ejcts.ch

Interactive CardioVascular and Thoracic Surgery

Downloaded from icvts.ctsnetjournals.org by on July 17, 2008