Short Time Interval Between Neurologic Event and Carotid Surgery Is Not Associated With an Increased Procedural Risk

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Background and Purpose—Guidelines recommend that carotid endarterectomy should be performed within 2 weeks in patients with a symptomatic carotid stenosis. Because a Swedish register study indicated that patients treated within the first days after a stroke or transient ischemic attack might have an increased perioperative stroke and mortality risk, this study aimed to find out whether these findings are also true under everyday conditions in Germany.

Methods—Secondary data analysis including 56,336 elective carotid endarterectomy procedures performed for symptomatic carotid stenosis under everyday conditions between 2009 and 2014. The patient cohort was divided into 4 groups according to time interval between index event and surgery (I: 0–2, II: 3–7, III: 8–14, and IV: 14–180 days). Primary outcome was any in-hospital stroke or death. For risk-adjusted analyses, a multilevel multivariable regression model was used.

Results—Mean patients’ age was 71.1±9.6 years; 67.5% were men. Overall rate of any stroke or death was 2.5% (n=1434). Risk of any in-hospital stroke or death was 3.0% in group I, 2.5% in group II, 2.6% in group III, and 2.3% in group IV. Multivariable regression analysis revealed that the time interval was not significantly associated with the primary outcome.

Conclusions—The time interval between the index event and carotid endarterectomy was not associated with the risk of any in-hospital stroke or death in patients with symptomatic carotid stenosis in Germany. In clinically stable patients, carotid endarterectomy might, therefore, be performed safely as soon as possible after the neurological index event.

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Key Words: amaurosis fugax ■ carotid stenosis ■ cohort studies ■ ischemic attack, transient ■ time interval

Current national and international guidelines recommend that carotid endarterectomy (CEA) be performed as early as possible (ideally within 2 weeks) after the neurological index event.® The 2007 UK National Stroke Strategy goes even further, by recommending that symptomatic carotid stenosis (>70%) in neurologically stable patients should be treated within 48 hours after a transient ischemic attack (TIA) or minor stroke.® Nevertheless, the risk of stroke or death because of early surgery has to be evaluated in light of the spontaneous risk of recurrent stroke after the initial event, as patients with a 50% to 99% symptomatic carotid stenosis are at a high risk of a recurrent neurological event within the first days or weeks after initial carotid-related ischemic symptoms. According to a recent review on this issue, the risk of stroke is as high as 6.4% (1.5–23.8%) during the first 2 to 3 days, 19.5% (12.7–28.7%) within 7 days, and 26.1% (20.6–32.5%) within 14 days after a carotid-related ischemic neurological event.® However, direct evidence comparing early surgery with conservative therapy or deferral is not available, because of the lack of randomized controlled trials. There are several studies reporting on the stroke and mortality risk after CEA in the early period after carotid-related neurological symptoms. Two single-center studies found no difference in the stroke and mortality risk depending on whether surgery was performed 0 to 2, 3 to 7, 8 to 14, or 15 to 180 days after the neurological index event.® However, 1 prospective registry study showed that patients treated within the first 2 days had a significantly increased perioperative mortality and stroke risk (11.5% within 48 hours versus 3.6% between 3 and 7 days).®

Therefore, the aim of this analysis was to analyze the association between the time interval (neurological index event to...
carotid surgery) and the risk of perioperative stroke or death on a national level in Germany.

Methods

Legal Basis of Data Acquisition

This secondary data analysis is based on the nationwide statutory quality assurance registry held by the Institute for Applied Quality Improvement and Research in Healthcare (AQUA Institute). Between 2009 and 2015, the AQUA Institute has been commissioned and authorized by the German Federal Joint Committee (G-BA, legal basis §91 German Social Security Code part 5, SGB V) to develop and implement external quality assurance in the German healthcare system pursuant to §137a SGB V. Furthermore, the AQUA Institute was also mandated for data validation, data analysis, and publication of annual quality reports.

In accordance with the G-BA directive concerning the measures of trans-sectoral and inpatient quality assurance, reporting of quality assurance data is compulsory for all reconstructive procedures on the extracranial carotid bifurcation. These reports include data on patients with statutory and private insurance, as well as patients without healthcare insurance and self-payers. Because of legal obligations, data collection thus covers nearly all (99.1%) CEA and carotid stenting procedures performed in German hospitals registered under §108 SGB V.

In 2014, our working group was granted access to this quality assurance data by the G-BA pursuant to §137a para. 10 SGB V. In addition, this study was approved by the Ethics Committee of the Technical University of Munich. This study was performed in accordance with the Good Practice of Secondary Data Analysis guidelines and the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement for observational studies, and the Technical University of Munich. This study was performed in accordance with the Good Practice of Secondary Data Analysis guidelines and the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement for observational studies.

Nonanonymized data were only accessed and displayed by controlled remote data processing and analysis. Conformance with German data protection laws was verified by the AQUA Institute staff member (T.K., T.B.).

Data Processing and Patient Grouping

The basic data set comprised 182033 patients treated for carotid stenosis with CEA or carotid artery stenting between 2009 and 2014. Patients were classified as asymptomatic, symptomatic stable, or symptomatic unstable before surgery by the surgeon or a specialist in neurology. This was performed in a structured fashion using a nationwide standardized data entry form provided by the AQUA Institute. After exclusion of asymptomatic patients (no symptoms associated with carotid stenosis in the past 6 months), patients treated with carotid artery stenting or combined procedures, patients with special conditions (eg, crescendo-TIA, stroke-in-evolution, and other emergency procedures), patients treated for other conditions (redo surgery for restenosis, aneurysms, symptomatic internal carotid artery, internal carotid artery coiling, symptomatic low-grade stenosis with ulcerated plaque morphology, tandem stenosis, and acute intracranial carotid artery occlusion), and 56336 patients undergoing elective CEA for symptomatic (amaurosis fugax, TIA, or stroke) carotid stenosis were included in the final analysis. See patient flowchart (Figure 1) for further details. In 57 patients, no information on the time interval was available; therefore, these patients were also excluded. As stated in the AQUA Institute annual reports, the overall completeness was 99.1%.

The following variables were considered relevant to our study: time from the last neurological event (index event) to the procedure, age, sex, physical status (American Society of Anesthesiologists stage), type of index event (amaurosis fugax, TIA, and minor/major stroke), ipsi- and contralateral degree of stenosis, periprocedural antiplatelet therapy, pre- and postprocedural neurological assessment (performed by a specialist in neurology), intraoperative neurophysiologic monitoring, surgical technique, type of anesthesia, shunt use, intraoperative check of technical success, clamping time, duration of surgery, pre- and postprocedural diagnostic imaging (ultrasound, transcranial Doppler sonography, computed tomographic angiography, and magnetic resonance angiography), and the annual center volume. The time interval between the index event and the time of CEA was categorized into 4 groups (0–2, 3–7, 8–14, and 15–180 days) to facilitate comparability with previous studies and guidelines. Severity of the qualifying event was classified using the modified Rankin Scale (mRS). An mRS of 0 to 2 points was considered minor, whereas an mRS of ≥3 was used to identify a major stroke. Determination of myocardial infarction was based on clinical diagnosis substantiated by elevation of biomarkers.

Outcomes and Statistics

The primary outcome of this study was any stroke or death occurring during the period commencing with initiation of CEA surgery and ending with discharge from hospital. Because of the legal framework, 30-day results were not available. Secondary outcomes were any major stroke or death, death alone, stroke, myocardial infarction (data only available for 2013 and 2014), and local complications (cranial nerve palsy, severe bleeding, and acute occlusion). Postoperative stroke was considered major if neurological impairments corresponded to an mRS of ≥3.

Nominal and ordinal variables were analyzed using contingency tables. For symmetrically distributed metric variables (eg, age), the arithmetic mean and SD were calculated. Variables showing a skewed distribution (eg, duration of surgery) were analyzed by calculating the median and the 25% and 75% percentiles (Q1, Q3). To calculate the adjusted risk ratio and 95% confidence intervals for the time interval (as an independent variable), a hierarchical Poisson regression model was applied. The primary outcome (any stroke or death) and the secondary outcomes any major stroke or death and all-cause death were used as dependent variables. To account for confounding and clustering, the variables age, sex, American Society of Anesthesiologists status, type of index event, ipsi- and contralateral degree of stenosis, periprocedural antiplatelet therapy, pre- and postprocedural neurological assessment, intraoperative neuromonitoring, surgical technique, type of anesthesia, shunt use, intraoperative patency check, clamping time, and center volume were entered into the model as fixed-effect factors, whereas the hospital site code and year of treatment were entered as random-effect factors (random intercept only). Model specification and variable selection were performed a priori, according to a prespecified analysis plan. As the cutoff values for grouping the time intervals were arbitrary, multivariable regressions analysis was also performed using the time interval as a continuous variable (fitted as a third-degree polynomial) on the
Table 1. Patient Characteristics

<table>
<thead>
<tr>
<th></th>
<th>Total</th>
<th>Time Interval Between Index Event and CEA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N=56,279</td>
<td>0–2 d (n=5198) 9.2%</td>
</tr>
<tr>
<td>Age, mean (SD), y</td>
<td>71.1 (9.6)</td>
<td>70.7 (9.9) 71.2 (9.7) 71.7 (9.5) 70.6 (9.3)</td>
</tr>
<tr>
<td>Male sex (%)</td>
<td>37,980 (67.5)</td>
<td>35,411 (68.1) 12,988 (67.9) 10,876 (67.1) 10,575 (67.1)</td>
</tr>
<tr>
<td>ASA category</td>
<td></td>
<td>I+II 14,394 (25.5) 1440 (27.7) 4997 (26.1) 3931 (24.3) 4026 (25.5)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>III 39,861 (70.8) 3512 (67.6) 13,508 (70.7) 11,643 (71.8) 11,198 (71.1)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>IV+V 2024 (3.6) 246 (4.7) 612 (3.2) 631 (3.9) 535 (3.4)</td>
</tr>
<tr>
<td>Ipsilateral degree of stenosis (% NASCET)</td>
<td></td>
<td>Mild (&lt;50) 767 (1.4) 92 (1.8) 253 (1.3) 208 (1.3) 214 (1.4)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Moderate (50–69) 4111 (7.3) 333 (6.4) 1391 (7.3) 1282 (7.9) 1105 (7.0)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Severe (70–99) 51,401 (91.3) 4773 (91.8) 17,473 (91.4) 14,715 (90.8) 14,440 (91.6)</td>
</tr>
<tr>
<td>Contralateral degree of stenosis (% NASCET)</td>
<td></td>
<td>Mild (&lt;50) 35,321 (62.8) 3378 (65.0) 12,168 (63.7) 9986 (61.6) 9789 (62.1)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Moderate (50–69) 10,449 (18.6) 888 (17.1) 3447 (18.0) 3180 (19.6) 2934 (18.6)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Severe (70–99) 7854 (14.0) 693 (13.3) 2628 (13.7) 2255 (13.9) 2278 (14.5)</td>
</tr>
<tr>
<td>Occlusion</td>
<td>2655 (4.7)</td>
<td>239 (4.6) 874 (4.6) 784 (4.8) 758 (4.8)</td>
</tr>
<tr>
<td>Qualifying/index event</td>
<td></td>
<td>AFX or retinal stroke 9859 (17.5) 852 (16.4) 2786 (14.6) 2689 (16.6) 3532 (22.4)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>TIA 20,439 (36.3) 2154 (41.4) 7237 (37.9) 5701 (35.2) 5347 (33.9)</td>
</tr>
<tr>
<td>Minor stroke (modified Rankin Scale score, 0–2)</td>
<td></td>
<td>14,368 (25.5) 1080 (20.8) 5170 (27.0) 4300 (26.5) 3818 (24.2)</td>
</tr>
<tr>
<td>Major stroke (modified Rankin Scale score, 3–5)</td>
<td></td>
<td>8591 (15.3) 860 (16.5) 3231 (16.9) 2622 (16.2) 1878 (11.9)</td>
</tr>
<tr>
<td>Other symptoms</td>
<td>3022 (5.4)</td>
<td>252 (4.8) 693 (3.6) 893 (5.5) 1184 (7.5)</td>
</tr>
<tr>
<td>Preoperative diagnostic procedures*</td>
<td></td>
<td>Duplex ultrasound 55,642 (98.9) 5088 (97.9) 18,926 (99.0) 16,040 (99.0) 15,588 (98.9)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Transcranial Doppler 22,633 (40.2) 2261 (43.5) 9017 (47.2) 6685 (41.3) 4670 (29.6)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Computed tomography angiography 18,512 (32.9) 1964 (37.8) 6649 (34.8) 5376 (33.2) 4523 (28.7)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Magnetic resonance angiography 28,063 (49.9) 2348 (45.2) 9393 (49.1) 8207 (50.6) 8115 (51.5)</td>
</tr>
<tr>
<td>Antiplatelet medication</td>
<td></td>
<td>None 3412 (6.1) 333 (6.4) 960 (5.0) 972 (6.0) 1144 (7.3)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mono (acetylsalicylic acid) 38,926 (69.1) 3713 (71.4) 13,883 (72.6) 11,133 (68.7) 10,162 (64.5)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mono (other than acetylsalicylic acid) 1421 (2.5) 108 (2.1) 473 (2.5) 437 (2.7) 401 (2.5)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Dual antiplatelet medication 2972 (5.3) 274 (5.3) 1116 (5.8) 853 (5.3) 719 (4.6)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Not available (not collected in 2009) 9605 (17.0) 770 (14.8) 2685 (14.0) 2804 (17.3) 3333 (21.1)</td>
</tr>
<tr>
<td>Neurological assessment</td>
<td></td>
<td>Preprocedural 49,007 (87.1) 4601 (88.5) 17,458 (91.3) 14,172 (87.5) 12,775 (81.1)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Postprocedural 34,913 (62.0) 3664 (70.5) 12,864 (67.3) 9835 (60.7) 8550 (54.3)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Pre- and postprocedural 33,693 (59.9) 3508 (67.5) 12,560 (65.7) 9581 (58.7) 8107 (51.4)</td>
</tr>
<tr>
<td>Length of stay in days (median, Q1–Q3)</td>
<td></td>
<td>5 (4–7) 6 (4–8) 5 (4–7) 5 (4–7) 5 (4–6)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Without event† 5 (4–7) 5 (4–8) 5 (4–7) 5 (4–7) 5 (4–6)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>With event† 10 (6–17) 11 (6–19) 9 (6–17) 11 (6–17) 11 (6–17)</td>
</tr>
</tbody>
</table>

AFX indicates amaurosis fugax; ASA, American Society of Anesthesiologists; CEA, carotid endarterectomy; n, patients with feature or property; N, all patients with information available; NASCET, North American Symptomatic Carotid Endarterectomy Trial; Q1–Q3, interquartile range; and TIA, transient ischemic attack.

*Multiple answers possible.
†Any in-hospital stroke or death.
basis of an exploratory approach. For data processing and statistical analysis, the statistical package R was used (version 3.2.1, The R Foundation, http://www.r-project.org). The R extension packages gmodels, lme4, and gam were used to calculate cross-classified tables, $\chi^2$ tests, and multivariable regression analyses. The significance level for all statistical tests was set to $\alpha=0.05$.

### Results

The mean age of all patients was 71.1 years (SD, 9.6 years) and 67.5% were men. Most patients were classified as American Society of Anesthesiologists stage III (70.8%). On the ipsilateral side, carotid artery stenosis was severe (70%–99%; Table 2).
North American Symptomatic Carotid Endarterectomy Trial (NASCET) in 91.3% of cases. On the contralateral side, 19% of patients had severe stenosis or an occlusion. The neurological index event was ipsilateral amaurosis fugax or retinal stroke in 17.5%, TIA in 36.3%, minor stroke (mRS, 0–2) in 25.5%, and major stroke (mRS, 3–5) in 15.3%. Overall, the median time interval was 9 days (Q1–Q3, 5–17 days). In 2009, the median time interval was 10 days (Q1–Q3, 9–21 days) and decreased to 8 days (Q1–Q3, 5–14 days) in 2014. In total, 9.2% of patients were treated within the first 2 days, 34.0% between days 3 and 7, 28.8% between days 8 and 14, and 28.0% were treated only after 15 days or longer. The median length of stay (LOS) in our cohort among patients without any in-hospital stroke or death was 5 days (Q1–Q3, 4–7 days), whereas among patients with any in-hospital stroke or death it was 10 days (Q1–Q3, 6–17 days). With respect to the time interval groups among patients with an event, median LOS was 11, 9, 11, and 11 days in groups I, II, III, and IV, respectively. Median LOS was 5 days in all groups I–IV among patients without an event. See Table 1 for further details on patients’ characteristics.

CEA was performed under general anesthesia in 72.5% of patients. Intraprocedural neurophysiologic monitoring was used in 58.9%. The most common surgical technique was endarterectomy with patching (53.0%), followed by the everolusion technique (39.8%). Primary or secondary shunting was applied in 48.1%. An intraoperative check of technical success was performed by sonography, angiography, or Doppler flowmetry in 67.5% of cases. The median duration of surgery was 86 minutes (Q1–Q3, 68–107 minutes), with a median clamping time of 15 minutes (Q1–Q3, 5–26 minutes). Detailed data on the surgical management of patients are listed in Table 2.

The in-hospital rate of any stroke or death (primary outcome) was 2.5% (n=1434). The overall risk of any major stroke or death was 1.9% (n=1055). The individual risks of perioperative stroke and perioperative death were 1.7% and 0.8%, respectively. With respect to the time interval groups, the risk of any stroke or death was 3.0% in time group I, 2.5% in group II, 2.6% in group III, and 2.3% in group IV. Any major stroke or death occurred at 2.2% in group I, 1.9% in group II, 2.0% in group III, and 1.6% in group IV. Myocardial infarction occurred in 0.4% (n=67 of 17954), cranial nerve palsy in 1.2% (n=652), severe bleeding in 2.5% (n=1435), and postoperative occlusions of the vessel in 0.3% (n=193; Table 3).

After adjusting for confounders and clustering of patients, regression analysis revealed that the time interval was not associated with the risk of any stroke or death (Figure 2). Moreover, no statistically significant association of the time interval and the risk of major stroke or death or all-cause death was found (Figure 2). Modeling the time interval as a continuous variable (Figure 3) also demonstrated no statistically significant association of the time interval with the risk of any stroke or death, with the risk of major stroke or death or with the risk of all-cause death (any stroke or death: \( P_{\text{linear}}=0.897, P_{\text{quadratic}}=0.283, P_{\text{cubic}}=0.567 \), major stroke or death: \( P_{\text{linear}}=0.591, P_{\text{quadratic}}=0.637, P_{\text{cubic}}=0.297 \), all-cause death: \( P_{\text{linear}}=0.157, P_{\text{quadratic}}=0.904, P_{\text{cubic}}=0.921 \)). Although not statistically significant, the relative risk for all-cause death showed an inverse linear relationship with the time interval (Figure 3).

**Discussion**

This secondary data analysis shows that the time interval between the neurological index event and surgery is not associated with the risk of any in-hospital stroke or death. These findings are in line with 2 single-center (n=1236) studies that used the same time interval groups.8,9 A systematic review on the pooled absolute risks of stroke or death after CEA in patients with recent TIA or nondisabling stroke found no significant difference between early and later surgery after the index event (<1 versus ≥1 week; odds ratio, 1.2; range, 0.9–1.7, n=6021).22 In addition, another single-center trial and a subgroup analysis
Figure 3. Multivariable regression analysis: Association of the time interval (as a continuous variable) between the neurological index event and carotid endarterectomy (CEA) on the risk of any stroke or death (A), any major stroke or death (B), and all-cause death (C). A relative risk (RR) of 1 corresponds to the average relative risk of all patients. CI indicates confidence interval.
of the Carotid Stenosis Trialists’ Collaboration data performed multivariable regression analyses comparing patients treated within 7 days after the index event with patients treated later. In accordance with the present analysis, neither study found any significant association between the time interval and the 30-day risk of any stroke or death. In contrast, the Swedish registry study by Strömberg et al. found a significantly increased perioperative risk of stroke or death when the procedure was performed within the first 2 days after the index event. Patients treated within the first 2 days had a 4-fold increased risk (risk ratio, 4.24; 95% confidence interval, 2.07–8.70) compared with patients treated between 3 and 7 days. However, no differences were found on comparing the reference group (3–7 days) to the other time interval groups (8–14 days: risk ratio, 1.12; 95% confidence interval, 0.62–2.02; 15–180 days: risk ratio, 1.90; 95% confidence interval, 1.12–3.22). One reason for the different findings may be the fact that at least some emergency procedures such as crescendo-TIA or stroke-in-evolution, which carry a markedly higher risk of stroke or death, were not excluded from the latter study. In this regard, a systematic review revealed a pooled absolute risk of stroke and death after CEA in patients with crescendo-TIA of 14.4% (95% confidence interval, 6.1–16.7; n=301) and 16.3% (95% confidence interval, 12.0–28.4; n=135) in patients with stroke-in-evolution. Interestingly, in the study by Strömberg et al. unstable neurological symptoms were neither associated with an increased stroke or mortality risk in the whole cohort nor did patients treated within 48 hours contribute many outcome events (only 1 patient who had a stroke within 48 hours had a crescendo-TIA as the index event). With respect to patients treated within the first 2 days after the index event, the reasons for the discrepant findings between the Swedish registry study and the present analysis remain unclear and are most likely multifactorial.

Because there is a high risk of recurrent events during the first days after a neurological event, the benefit of preventing stroke by performing surgery as early as possible seems to be obvious. This benefit may even exceed a possibly increased surgical risk (as suggested by the Swedish registry study) if CEA is performed within the first 48 hours although a randomized trial design would be required to prove such a causal relationship.

Even though this is the largest and most complete registry on CEA procedures in Germany, several limitations of the study design should not go unmentioned. First of all, this is a retrospective observational study. Therefore, only associations—rather than causal relationships—can be inferred from the data. Furthermore, the results might be biased by the LOS because the database does not provide 30-day follow-up information. LOS was longer in patients with a documented outcome event. This might have been caused by a longer period at risk, but is most likely because of the occurrence of the event itself (reversed causation). However, LOS (period at risk) is homogeneous across all time interval groups (Table 1) and, therefore, bias because of differing periods at risk is considered low with respect to the primary subject of comparison of this study (time interval). Furthermore, most events occur within the first days after surgery. In addition, this registry contains only patients who actually received CEA. Patients having symptomatic internal carotid stenosis not undergoing elective CEA treatment were not documented in the database. In addition, although >90% of all patients were assessed by a specialist in neurology before surgery, the distinction between neurologically stable and unstable patients remains clinically challenging, particularly during the first hours after onset of symptoms. Furthermore, the definition of the time interval groups was based only on the literature and is therefore arbitrary. Nevertheless, analysis of the time interval as a continuous variable supported the main findings of this study. In addition, only 62% of all patients were assessed by a specialist in neurology after surgery. Nevertheless, pre- and postoperative assessment by a neurologist was entered into the multivariable regression model, and therefore information bias is considered low. Another limitation of the study is that the data are self-reported by the provider performing the procedure.

Conclusions

Including >56 000 CEA procedures, this secondary data analysis is currently the largest study investigating the association between the time interval and perioperative neurological outcomes. In summary, this study shows that the time interval between the neurological index event and the time of surgery was not associated with the risk of any in-hospital stroke or death under everyday conditions in Germany between 2009 and 2014. Thus, with respect to clinically stable patients, this study revealed no evidence, which contradicts current guidelines recommending that CEA can be performed as soon as possible after a neurological event.

Disclosures

None.

References


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/content/47/12/e279.full.pdf

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In the article by Tsantilas et al, “Short Time Interval Between Neurologic Event and Carotid Surgery Is Not Associated With an Increased Procedural Risk,” which published online on October 13, 2016, and appeared in the November 2016 issue of the journal (Stroke. 2016;47:2783–2790. DOI: 10.1161/STROKEAHA.116.014058), a correction is needed.

On page 2783, in the Key Words, “systolic time interval” is changed to read, “time interval.”

This correction has been made to the current online version of the article, which is available at http://stroke.ahajournals.org/content/47/11/2783.