Letter by Naylor Regarding Article, “Urgent Best Medical Therapy May Obviate the Need for Urgent Surgery in Patients With Symptomatic Carotid Stenosis”

To the Editor:

Shahidi et al are to be congratulated for showing that delays to carotid endarterectomy can be reduced through reconfiguring services and that strokes might be prevented by starting dual antiplatelet therapy in the referring clinic. However, I would urge a little caution before recommending that urgent aggressive best medical therapy may obviate the need for urgent carotid endarterectomy.

Nearly one third of the patients in this series experienced ≥1 neurological event within 90 days of the index event (ie, there was a considerable delay in getting many of the vulnerable patients to seek medical advice). Given the compelling natural history evidence that the highest risk period for recurrent stroke is the first few days after experiencing the first transient ischemic attack, it is highly likely that some of the highest-risk patients in their region experienced a transient ischemic attack followed by an early stroke and were not referred for surgery (ie, the cohort undergoing surgery by the time they were finally referred in this series was not as high risk for stroke than if all patients had been seen as soon as possible after their first neurological event). This is not a criticism of their reconfigured service, but rather a timely reminder of just how important it is to get patients seen as soon as possible after experiencing their first neurological event.

Leicester, United Kingdom, instituted a similar rapid-access service in 2008, and the median delay from first symptom to surgery has fallen to 8 days. Despite starting best medical therapy before attending the transient ischemic attack clinic and then transferring patients directly to the vascular unit for expedited surgery, 11% experienced recurrent neurological events in between hospital admission and surgery. In 2 patients, the strokes were disabling, and carotid endarterectomy could not be performed. Therefore, it remains to be seen whether implementing dual antiplatelet therapy and statins immediately after the first neurological event is able to obviate the need for urgent carotid endarterectomy. Until then, I would continue to advocate starting aggressive medical therapy and to perform carotid endarterectomy as soon as possible.

Disclosures

None.

A. Ross Naylor, MD, FRCS
Department of Vascular Surgery
Leicester Royal Infirmary
Leicester, United Kingdom

Letter by Naylor Regarding Article, "Urgent Best Medical Therapy May Obviate the Need for Urgent Surgery in Patients With Symptomatic Carotid Stenosis"

A. Ross Naylor

Stroke. published online October 10, 2013;

Stroke is published by the American Heart Association, 7272 Greenville Avenue, Dallas, TX 75231
Copyright © 2013 American Heart Association, Inc. All rights reserved.
Print ISSN: 0039-2499. Online ISSN: 1524-4628

The online version of this article, along with updated information and services, is located on the World Wide Web at:

http://stroke.ahajournals.org/content/early/2013/10/10/STROKEAHA.113.003329.citation

Data Supplement (unedited) at:

http://stroke.ahajournals.org/content/suppl/2013/10/10/STROKEAHA.113.003329.DC1

Permissions: Requests for permissions to reproduce figures, tables, or portions of articles originally published in Stroke can be obtained via RightsLink, a service of the Copyright Clearance Center, not the Editorial Office. Once the online version of the published article for which permission is being requested is located, click Request Permissions in the middle column of the Web page under Services. Further information about this process is available in the Permissions and Rights Question and Answer document.

Reprints: Information about reprints can be found online at:
http://www.lww.com/reprints

Subscriptions: Information about subscribing to Stroke is online at:
http://stroke.ahajournals.org/subscriptions/
Delay Prior to Expedited Carotid Endarterectomy: A Prospective Audit of Practice

M. Ali, J. Stephenson, A.R. Naylor *
Department of Vascular Surgery, Leicester Royal Infirmary, Leicester, UK

WHAT THIS PAPER ADDS
A service reconfiguration was undertaken in order that carotid endarterectomy (CEA) was performed as soon as possible in the hyperacute period after onset of symptoms. This audit shows that although 85% of patients underwent CEA in less than 14 days from the index symptom, there were still avoidable delays in the patient pathway, mostly caused by the absence of weekend operating. Preventing delay is of clinical relevance because (despite starting optimal medical therapy in the TIA Clinic), 11% of patients suffered a recurrent TIA/stroke between admission and surgery.

Objectives: To identify reasons for delay before carotid endarterectomy (CEA) in a reconfigured “fast-track” system where patients were admitted from the TIA Clinic for urgent CEA.

Methods: Prospective audit in 89 recently symptomatic patients.

Results: Ten patients (11%) suffered recurrent symptoms between admission and surgery. Two strokes were sufficiently severe that CEA was cancelled. The median delay from index symptom to CEA was 8 days. 74/87 (85%) underwent CEA <14 days from the index symptom; 39/87 (45%) within 7 days. Forty-five (51%) were ready for CEA <24 hours of admission; 74 (83%) <72 hours. The most common reasons for delay to CEA were logistical, especially a failure to plan for access to weekend operating. Two-thirds of the Tuesday/Friday theatre lists that were reserved for urgent CEAs were actually used for CEA; 27 (33%) were not used for CEA but were utilized for another vascular procedure, and five (4%) were cancelled the day before and went unused.

Conclusions: The vast majority of patients (85%) underwent CEA <14 days from the index symptom, but 11% still suffered recurrent symptoms prior to surgery. Transferring patients directly from the TIA Clinic reduced overall delays, but Vascular Units adopting such an approach might then be vulnerable to criticisms regarding prolonged lengths of pre-operative in-patient stay while patients were worked up for theatre. Protected theatre lists both optimized and delayed access to CEA, but the most important cause of delay was that we had not planned for weekend operating using specialist anaesthetic and theatre staff.

© 2013 European Society for Vascular Surgery. Published by Elsevier Ltd. All rights reserved.

Article history: Received 8 April 2013, Accepted 23 July 2013, Available online XXX

Keywords: Carotid endarterectomy, TIA, Stroke, Rapid treatment

INTRODUCTION
It has traditionally been taught that the risk of recurrent stroke after a transient ischaemic attack (TIA) or minor stroke is 1–2% at 28 days. However, contemporary meta-analyses of population-based, natural history studies suggest that the risk may be significantly higher. 1 Relatively few natural history studies have analyzed the risk of early recurrent stroke in the first 7–14 days after suffering a TIA in patients with an ipsilateral 50–99% stenosis, but the available data (Table 1) suggest that the risks may be considerable. 2–5

* Corresponding author. Vascular Research Group, Division of Cardiovascular Sciences, Clinical Sciences Building, Leicester Royal Infirmary, Leicester LE2 7LX, UK.
E-mail address: ross.naylor@uhl-tr.nhs.uk (A.R. Naylor).
1078-5884/$ see front matter © 2013 European Society for Vascular Surgery. Published by Elsevier Ltd. All rights reserved.
http://dx.doi.org/10.1016/j.ejvs.2013.07.015

The combination of a higher than expected risk of early recurrent stroke (despite best medical therapy), in association with meta-analyses suggesting that carotid endarterectomy (CEA) confers maximum benefit if performed as soon as possible, 6 has catalyzed a worldwide drive towards performing CEA as soon as possible after the index event.

In October 2008, a reconfigured “Rapid Access” TIA service was introduced in Leicester. One of the goals was to ensure that patients suffering a TIA/minor stroke underwent CEA as soon as possible after onset of symptoms. 7 To facilitate expedited CEA, patients with an ipsilateral 50–99% stenosis (NASCET measurement method) were commenced on optimal medical therapy in the TIA Clinic and then transferred directly to the Vascular Unit for expedited CEA. No provision for weekend operating was included in the protocol, but two half-day theatre lists (Tuesdays/Fridays) were kept free for urgent CEAs. The current audit was undertaken to determine if there were...
recently symptomatic and referred via the Leicester Vascular Unit, of which 89 were performed in the Leicester Vascular Unit, of which 89 were recently symptomatic and referred via the Leicester “Rapid Access” TIA service or directly from the Stroke Unit. The remaining 22 patients were asymptomatic (n = 12) or were symptomatic and referred from outwith Leicestershire (n = 10). The latter group had not been referred via the Leicester Rapid Access Clinic, and we had no reliable data regarding who had suffered additional cerebral vascular events prior to referral or (more importantly) whether there were other patients who might have been considered for CEA, but who then suffered a stroke and were never referred. The Leicestershire, Northamptonshire and Rutland Research Ethics Committee advised that this study did not fall under the remit of the NHS Research Ethics Committee, as it was audit/service evaluation.

### MATERIALS AND METHODS

Between March 1, 2011 and April 30, 2012, 111 CEAs were performed in the Leicester Vascular Unit, of which 89 were recently symptomatic and referred via the Leicester “Rapid Access” TIA service or directly from the Stroke Unit. The remaining 22 patients were symptomatic (n = 12) or were symptomatic and referred from outwith Leicestershire (n = 10). The latter group had not been referred via the Leicester Rapid Access Clinic, and we had no reliable data regarding who had suffered additional cerebral vascular events prior to referral or (more importantly) whether there were other patients who might have been considered for CEA, but who then suffered a stroke and were never referred. The Leicestershire, Northamptonshire and Rutland Research Ethics Committee advised that this study did not fall under the remit of the NHS Research Ethics Committee, as it was audit/service evaluation.

#### Rapid Access TIA Clinic

The Rapid Access TIA Clinic operates every day of the year, thereby enabling patients to be seen as soon as possible after onset of symptoms. A fuller description of the service has been detailed elsewhere. The protocol advises the referring Family Doctor or Emergency Department to administer 300 mg aspirin and 40 mg simvastatin to all patients with a suspected TIA at the time of being seen and these medications were continued until the patient was seen in the Clinic. In the TIA Clinic, patients underwent CT/MR imaging plus carotid ultrasound imaging and they were then seen by a consultant who specialized in stroke medicine. Provided there was no evidence of intracranial haemorrhage, a further 300 mg aspirin and 40 mg simvastatin were administered in the clinic. Any patient with an ipsilateral 50–99% carotid stenosis was then transferred directly to the Surgical Admissions Unit (SAU) for expedited CEA, unless contra-indicated.

#### Expedited CEA

Following transfer to the SAU (usually in the late afternoon), each patient underwent work-up for theatre. The goal was to perform CEA as safely and as soon as possible. Uncontrolled hypertension (systolic >180 mmHg) was stabilized prior to surgery. Aspirin and statin therapy were continued throughout the peri-operative period (the aspirin dose was reduced to 75 mg) and a 75 mg of clopidogrel was administered the night before surgery. Two half-day theatre lists were kept free for urgent carotid cases (Tuesday and Friday). If these lists were filled, alternative arrangements were made (emergency theatre, ad hoc space on other elective vascular theatre lists, allocation to the next unfilled CEA list). Wherever possible, the aim was to minimize delay. During the course of this audit, expedited CEA was not performed on a Saturday or Sunday.

### Results

Eighty-nine recently symptomatic patients were admitted via the Rapid Access TIA Clinic (n = 82) or from the Stroke Unit (n = 7). Fig. 1 shows the temporal pattern of admissions. About 70% were admitted between Monday and Thursday, whereas only 30% were admitted over the weekend (usually on a Sunday). More patients were admitted on a Thursday than any other day. The implications of these temporal patterns will be discussed later.

Two patients suffered disabling strokes following SAU admission and never underwent CEA (see below). Fig. 2 details how quickly the 87 remaining patients were deemed “fit” to undergo CEA after admission (blue bars) and how quickly they then underwent CEA (red bars). The median delay from index symptom to surgery was 8 days (95% CI: 7 to 9), and the median delay from admission to CEA was 3 days (95% CI: 3 to 4).

In practice, most patients admitted from the TIA Clinic arrived in the late afternoon and this had an inevitable impact on the ability to rapidly complete work-up for surgery. Overall, only 8% of patients completed full surgical work-up on the day of SAU admission; 52% were ready the following day, 80% were ready in <48 hours, and 85% completed their work-up within 72 hours. Out of the 87 patients with a suspected TIA at the time of being seen and these medications were continued until the patient was seen in the Clinic. In the TIA Clinic, patients underwent CT/MR imaging plus carotid ultrasound imaging and they were then seen by a consultant who specialized in stroke medicine. Provided there was no evidence of intracranial haemorrhage, a further 300 mg aspirin and 40 mg simvastatin were administered in the clinic. Any patient with an ipsilateral 50–99% carotid stenosis was then transferred directly to the Surgical Admissions Unit (SAU) for expedited CEA, unless contra-indicated.

#### Expedited CEA

Following transfer to the SAU (usually in the late afternoon), each patient underwent work-up for theatre. The goal was to perform CEA as safely and as soon as possible. Uncontrolled hypertension (systolic >180 mmHg) was stabilized prior to surgery. Aspirin and statin therapy were continued throughout the peri-operative period (the aspirin dose was reduced to 75 mg) and a 75 mg of clopidogrel was administered the night before surgery. Two half-day theatre lists were kept free for urgent carotid cases (Tuesday and Friday). If these lists were filled, alternative arrangements were made (emergency theatre, ad hoc space on other elective vascular theatre lists, allocation to the next unfilled CEA list). Wherever possible, the aim was to minimize delay. During the course of this audit, expedited CEA was not performed on a Saturday or Sunday.

### Prospective audit

A prospective audit was maintained of the patient pathway starting from admission to the SAU to undergoing CEA. Referral was defined as the time when the TIA Clinic or Stroke Unit contacted the vascular on-call team to inform them that there was a potential patient who might require expedited CEA. Admission was defined as the day when the patient was actually admitted to the SAU. The index symptom was defined as the clinical event that led the patient to seek medical advice and referral to the TIA Clinic. Each day, the pathway was updated to take account of whether the patient was deemed fit for surgery, with documentation of reasons for any ongoing delay (e.g., poorly controlled hypertension requiring treatment, ongoing investigations). Once the patient was considered fit for CEA, the audit then documented reasons for any additional delay before undergoing surgery.
patients who underwent CEA, nine (10%) underwent CEA the day after admission, increasing to 39% at 48 hours and 59% by 72 hours. By day 5, 86% had undergone surgery (92% by day 7). Overall, 74 patients (85%) underwent CEA <14 days from suffering their index symptom, and 39 (45%) underwent surgery within 7 days.

In seven patients (8%), there was a >7 day delay between SAU admission and undergoing surgery. Three of the seven required prolonged workup because of co-morbidities requiring multi-disciplinary input (usually cardiac pathology or uncontrolled hypertension), and a fourth suffered a recurrent TIA on a Friday and a decision was made to list him for CEA after the weekend. A fifth patient on chronic clopidogrel therapy had his medication stopped for 5 days because of concerns about intra-operative bleeding. The sixth patient was worked up for theatre, but then suffered a seizure. The procedure was deferred until a neurological review was undertaken. The seventh patient was scheduled for a “semi-elective” procedure, as both the Tuesday/Friday CEA lists were full that week and the patient had presented with a single episode of amaurosis and was considered at lower risk for suffering a stroke.

Overall, 53/87 patients (61%) underwent CEA within 24 hours of being worked up for surgery. However, this statistic masks the fact that 55 patients (63%) did not undergo CEA in <48 hours of admission (Table 2). The two most common reasons for delay >48 hours were logistical and accounted for 37/55 (67%) of the observed delays: (a) admission immediately prior to or during the weekend where access to full-work up was occasionally compromised and/or there was no access to performing CEA over the weekend, and (b) the patient was simply allocated to the next available Tuesday/Friday CEA theatre list, which could incur a day or so of additional delay. Nine of the 55 patients had unavoidable reasons for delay to surgery >48 hours after admission (extended investigations because of co-
morbidities \( n = 6 \), severe uncontrolled hypertension \( n = 3 \).

Between March 1, 2011 and April 30, 2012, there were 121 Tuesday/Friday operating lists that were kept free for urgent CEAs. These were utilized for expedited CEA on 77 occasions (64%); 39 (32%) were not used for CEA, but were then utilized for other vascular procedures; and five (4%) were cancelled the day before and went unused (i.e., the theatre list was wasted).

Ten patients (11%) suffered recurrent symptoms in between admission to the SAU and undergoing surgery. Eight were TIAs, and two were disabling strokes (neither were subsequently fit enough to undergo surgery). Table 3 summarizes the patterns of delay in these patients, who had all commenced medical therapy in the TIA Clinic, which was then continued throughout their in-patient stay. Eight of the ten were admitted within 5 days of suffering their index cerebral vascular event (five within 3 days); 5/10 patients suffered their recurrent event either on the same day that they were admitted to SAU \( n = 2 \) or within the first 24 hours \( n = 3 \). Eight of the ten recurrent symptoms occurred <48 hours from admission (including the two suffering disabling strokes). All but two eventually underwent CEA (six on the day following the recurrent event). Table 3 also details the reason why five patients who suffered recurrent symptoms did not undergo CEA <48 hours from admission (uncontrolled hypertension \( n = 2 \); allocated to next available CEA list \( n = 2 \), ongoing work-up \( n = 1 \)).

**DISCUSSION**

In 2006 (and in common with many other vascular units around the world), the median delay from referral to CEA in Leicester was about 40 days. In the current audit, patients were transferred to the SAU on the day of referral (the day of referral was almost always also the day of admission) and the median delay from referral to CEA was 3 days (95% CI: 3 to 4), and the median delay from index symptom to CEA was 8 days (95% CI: 7 to 9). Overall, 85% of patients underwent CEA <14 days (i.e., well within the European Society of Vascular Surgery (ESVS) and NICE Guidelines\(^{11,12}\)) and 39 (45%) underwent surgery <7 days from the index event.

The single most important factor in reducing the delay to surgery (compared with 2006) was the introduction of the daily single-visit TIA Clinic in October 2008. The Leicester TIA service has since been “showcased” by the UK Department of Health as being an example of how 7-day working should be delivered in the NHS.\(^{13}\) Accordingly, it would have been easy to have concluded that this audit had shown that the reconfigured service was delivering a high-quality service and that it had achieved its goal of meeting the ESVS/NICE 14-day target. In addition, its trio of practical components (starting medical therapy in the clinic, immediate transfer to the SAU and protected Tuesday/Friday operating lists) were generalizable into clinical practice elsewhere.

However, despite achieving the 14-day treatment threshold in the majority of patients, this audit has revealed that this particular pathway of care involved patients spending (on average) 3 days on the SAU before undergoing their operation, during which time they were exposed to a heightened risk of recurrent stroke. In addition, the Vascular Unit accumulated increased in-patient costs (during work-up for surgery) that were never considered when tariffs were based on elective admissions and an entire in-patient stay of <72 hours.

There were numerous reasons for the delays encountered, but most were logistical (i.e., avoidable) as opposed to being patient mediated (mostly unavoidable). Table 2 details the reasons why 55 patients did not undergo surgery within 48 hours of admission. Delays were deemed “unavoidable” in 15 patients (27%), where reasons included protracted investigation in patients with multiple comorbidities (usually cardiac) \( n = 6 \), uncontrolled hypertension \( n = 3 \), and miscellaneous medical reasons \( n = 6 \). In 37 patients (73%), however, the delays were logistical. The most common single reason for delay was our weekend working practices, or lack of them (24/55 [44%]). Although it was usually possible to complete a baseline work-up for theatre at the weekend, it was not usually possible to obtain consultations from other medical specialties (e.g., cardiac, respiratory, renal) over the weekend. These usually had to wait until the Monday. In addition, our lack of weekend operating effectively meant that anyone who was admitted from Thursday evening onwards tended to wait until the following Tuesday before undergoing his/her operation.

The lack of weekend operating in Leicester (and in most European units) is largely historical (no-one ever really thought it necessary in CEA patients), but for most centres this would probably entail performing CEA in the general duties emergency theatre without the support of specialist vascular anaesthetists, vascular theatre staff, and monitoring technicians. It would also mean trying to fit in CEA patients around other equally deserving multi-specialty

---

**Table 2. Reasons for delay in 55 patients who did not undergo carotid endarterectomy (CEA) within 48 hours of admission.**

<table>
<thead>
<tr>
<th>Reason</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Admitted immediately prior to or during weekend/no operating at weekend</td>
<td>24</td>
</tr>
<tr>
<td>Patients allocated to next Tuesday/Friday CEA list</td>
<td>13</td>
</tr>
<tr>
<td>Extended investigations (concurrent co-morbidities)</td>
<td>6</td>
</tr>
<tr>
<td>Patients required treatment of uncontrolled hypertension</td>
<td>3</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>9</td>
</tr>
<tr>
<td>Pre-existing neurological deficit too severe</td>
<td>1</td>
</tr>
<tr>
<td>Allocated to “non-CEA” theatre list</td>
<td>1</td>
</tr>
<tr>
<td>No consultant surgeon available</td>
<td>1</td>
</tr>
<tr>
<td>Small haemorrhage within recent infarct</td>
<td>1</td>
</tr>
<tr>
<td>Ran out of theatre time</td>
<td>1</td>
</tr>
<tr>
<td>Patient initially decided against surgery</td>
<td>1</td>
</tr>
<tr>
<td>Clopidogrel had to be stopped</td>
<td>1</td>
</tr>
<tr>
<td>Warfarin had to be stopped</td>
<td>1</td>
</tr>
<tr>
<td>Anaphylactic reaction to teicoplanin</td>
<td>1</td>
</tr>
</tbody>
</table>

---

Please cite this article in press as: Ali M, et al., Delay Prior to Expedited Carotid Endarterectomy: A Prospective Audit of Practice, European Journal of Vascular and Endovascular Surgery (2013), http://dx.doi.org/10.1016/j.ejvs.2013.07.015
emergencies. In Leicester, there is no dedicated emergency vascular anaesthesia rota (which is essential for performing urgent CEAs at weekends), most of our general duties theatre nurses can set up the completion angiography equipment, but we would not have access to our transcranial Doppler technicians. Unless resources were specifically allocated to address these staffing issues, it would mean performing CEA in less than optimal circumstances.

The second most common reason for delay (paradoxically) was our over-reliance on the Tuesday/Friday CEA lists. With the exception of these two theatre lists (which were kept free until the last minute), all the other weekly vascular theatre lists were already filled with scheduled open and endovascular procedures (i.e., there was usually very little flexibility for adding urgent CEA cases). Accordingly, it became all too easy to allocate the TIA patient to someone with a 50–99% stenosis is now prioritized to be seen first by the stroke physician, thereby enabling earlier admission to the surgical unit.

A second strategy would be to implement an even more aggressive approach to “best medical therapy”. In Leicester, all patients were started on aspirin and a statin prior to TIA Clinic referral and all received 75 mg clopidogrel the night before surgery. It may well be that clopidogrel should also be started in the TIA Clinic (once CT/MRI has excluded an intracranial haemorrhage) and then continued until surgery, the rationale being that dual antiplatelet therapy might reduce the risk of early recurrent embolic stroke. The role of dual antiplatelet therapy in this setting has not been evaluated, but is the subject of a new audit in our Unit.

### Table 3. Delay data in 10 patients suffering recurrent symptoms after admission to the Surgical Admissions Unit (SAU) but before undergoing surgery.

<table>
<thead>
<tr>
<th>Gender and age</th>
<th>Delay: index event to SAU admission</th>
<th>Delay: SAU admission to recurrent symptom</th>
<th>Delay: recurrent symptom to CEA</th>
<th>Recurrent symptom</th>
<th>Reason CEA not done &lt;48 hours of SAU admission</th>
<th>Reason CEA not done day after recurrent symptom</th>
</tr>
</thead>
<tbody>
<tr>
<td>74 M</td>
<td>3 days</td>
<td>Same day</td>
<td>Next day</td>
<td>TIA</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>69 M</td>
<td>3 days</td>
<td>Same day</td>
<td>3 days</td>
<td>TIA</td>
<td>Allocated to next CEA list</td>
<td>Allocated to next CEA list</td>
</tr>
<tr>
<td>71 F</td>
<td>4 days</td>
<td>&lt;24 hours</td>
<td>CEA cancelled</td>
<td>Disabling stroke</td>
<td>n/a</td>
<td>Disabling stroke</td>
</tr>
<tr>
<td>75 F</td>
<td>13 days</td>
<td>&lt;24 hours</td>
<td>Next day</td>
<td>TIA</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>62 M</td>
<td>5 days</td>
<td>&lt;24 hours</td>
<td>Next day</td>
<td>TIA</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>66 F</td>
<td>10 days</td>
<td>&lt;48 hours</td>
<td>Next day</td>
<td>TIA</td>
<td>Uncontrolled hypertension</td>
<td>n/a</td>
</tr>
<tr>
<td>81 F</td>
<td>4 days</td>
<td>&lt;48 hours</td>
<td>CEA cancelled</td>
<td>Disabling stroke</td>
<td>Work-up still ongoing</td>
<td>Disabling stroke</td>
</tr>
<tr>
<td>78 F</td>
<td>2 days</td>
<td>&lt;48 hours</td>
<td>Next day</td>
<td>TIA</td>
<td>Allocated to next CEA list</td>
<td>n/a</td>
</tr>
<tr>
<td>83 M</td>
<td>3 days</td>
<td>3 days</td>
<td>Next day</td>
<td>TIA</td>
<td>Uncontrolled hypertension</td>
<td>n/a</td>
</tr>
<tr>
<td>85 F</td>
<td>1 day</td>
<td>5 days</td>
<td>3 days</td>
<td>TIA</td>
<td>Weekend</td>
<td>Weekend</td>
</tr>
</tbody>
</table>

CEA = carotid endarterectomy; TIA = transient ischaemic attack.
The third strategy would be to abandon the twice-weekly protected carotid theatre lists and simply add any urgent CEA patient to the following days operating list, irrespective of what was already on it. This is relatively easy to implement, it would certainly reduce pre-operative delays (although not at the weekend), but it would require that the theatre, anaesthetic, and vascular surgical staff would have to agree to stay late once or twice per week if required.

A fourth option would be to utilize the general duties emergency theatre at the weekend. For most vascular units, this would probably entail working with anaesthetic and/or nursing staff that were unfamiliar with this type of high-risk patient and there would be the inevitable battle with other specialties for priority in the emergency theatre. In Leicester, there is already heavy pressure on accessing the all-day emergency theatre. Although superficially attractive, it is probably the least desirable option in terms of delivering optimal care, in-hours surgery, and patient safety.

A fifth strategy would be to move the Friday CEA list to a Thursday and then have a dedicated CEA list on a Saturday morning with specialist vascular anaesthetists, theatre nurses, and monitoring staff rostered to attend. This, inevitably, has cost implications and might be a reasonable strategy in larger volume units, but would probably not be practical nor cost-effective in smaller units.

The final option would be to only undertake weekend operating on patients considered to be at highest risk of suffering a stroke. This policy would reduce overall staff/theatre utilization at the weekend (i.e., reduce costs) and would enable “lower-risk” patients to be deferred to the following week. Of course, the key issue would be how to identify these “high-risk” patients. A low GSM (<25) has previously been shown to be predictive of an increased risk of suffering recurrent symptoms following admission, while the presence of spontaneous embolization on TCD is a recognized marker of plaque instability and an increased risk of early stroke. A third potential means of identifying high-risk patients for prioritized weekend operating might be via the combination of a high ABCD2 score and the presence of infarction on CT/MRI. Giles et al. have shown that an ABCD2 score of 0–3, 4–5, and 6–7 in the absence of CT/MRI infarction was associated with relatively low recurrent stroke rates of 0.2%, 1.4%, and 3.3% at 7 days respectively. By contrast, an ABCD2 score of 0–3, 4–5, and 6–7 in the presence of recent infarction on CT/MRI was associated with a stepwise increase in early stroke risk (2.3%, 8.9%, and 15% respectively). These three imaging strategies for identifying high risk for stroke patients merit further study, but they have not (so far) been validated for translation into clinical practice.

In conclusion, almost 50% of patients underwent CEA within 7 days of the index event in the reconfigured service. Despite this, patients still spent almost 3 days in the surgical unit before undergoing CEA. The most common single reason for delay was a lack of operating during the weekend. This audit was designed to identify reasons for delay (rather than how to avoid them), but the logistical issues identified (and their potential solutions) may assist other services who are planning similar reconfigurations in practice.

**FUNDING**

This audit was funded by an Innovation Award from the East Midlands Strategic Health Authority.

**CONFLICT OF INTEREST**

None.

**REFERENCES**

7. Salem MK, Sayers RD, Bown MJ, Eveson DJ, Robinson TG, Naylor AR. Rapid access carotid endarterectomy can be performed without a significant increase in the procedural risk. *Eur J Vasc Endovasc Surg* 2011;41:222–8.
14. Salem MK, Sayers RD, Bown MJ, West K, Moore D, Nicolaides AN, et al. Patients with recurrent ischaemic events...
from carotid artery disease have a large lipid core and low GSM. *Eur J Vasc Endovasc Surg* 2012;43:147–53.
